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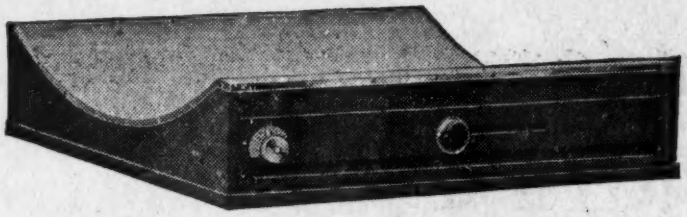

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A BIOPHYSICAL LAW GOVERNING SURGICAL MORTALITY[1]

BY GEORGE W. CRILE, M.D., F.A.C.S., CLEVELAND

IN the death of John Benjamin Murphy the world lost one of its greatest surgeons and the American surgical profession, its leader. The light of his versatile genius had pointed the way to a rational surgery of the abdomen; it had made epochal progress in the surgery of the bones and joints; it had advanced the treatment of tuberculosis; it had made notable contributions to the surgery of the lungs; it had illumined the intricate fields of surgery of the nerves and of the blood vessels.

John B. Murphy was more than a master surgeon. He was a brilliant teacher and a talented author. The Murphy Clinic was the Mecca to which surgeons from all parts of the world came for inspiration. His clinical lectures in their lucidity, logical deductions, and originality were unequaled; and from no other clinic have there issued so many original and practical contributions to surgery. Dr. Murphy's dicta regarding new procedures were always accepted with confidence in the knowledge that before applying them himself, every step had been verified by painstaking researches—researches in which he was stimulated and encouraged by the co-operation of his constant collaborator, Mrs. Murphy.

Tonight we commemorate the services of this great surgeon, teacher, author. Since these qualities were based upon a keen interest and participation in original research, it would seem fitting on this occasion to offer as the subject of this oration a theory based upon certain researches of my associates and myself in the Biophysical Laboratory of the Cleveland Clinic.

For many years medical science has been endeavoring to identify the form of energy that drives the organism of man and animals; to discover the physical laws in accordance with which that energy operates; and to determine the conditions which lead to progressive or immediate loss of energy and death.

Since the surgeon deals with the injured and acutely diseased man; since he opens the living organism to remove tumors, to overcome infections, to relieve obstructions, and to correct deformities; since he modifies the organism by means of stimulants, sedatives, and anæsthetics, the surgeon is peculiarly and more than any other individual in a position to learn at first hand the changes wrought within the organism by injury, by operation, and by disease.

In the many efforts which have been made to find a fundamental law based alone on the observations of the physiologist and the pathologist, no premise has been formulated whereby the surgeon could interpret the vital processes. In the Cleveland Clinic, therefore, we have turned to physics in our search for light upon this fundamental problem, and it is my purpose on this occasion to present the summaries of experimental and clinical evidence in support of a physical law which governs the so-called vital processes of the organism.

[1]The Murphy oration delivered before the Clinical Congress of American College of Surgeons, Chicago, October 23, 1923.

Animals are transformers of energy; it follows, therefore, that animals must be operated by means of one or more of the following six forms of energy: (1) heat, (2) light, (3) gravitation, (4) intermolecular forces, (5) chemical energy, (6) electric energy.

It is obvious that the organism of a rabbit, for example, is not operated by heat energy; nor by light energy; nor by gravitational forces; nor by surface energy. It follows that the probable driving force of animals must be either electrical or chemical energy, or a combination of both. We therefore propose the theory that animals are electro-chemical mechanisms. If this theory is tenable it must meet the following requirements:

1. That electricity is a constant phenomenon of living processes. This has long been known.

2. That the application of electricity to the muscles or glands, or to their nerve supply will cause them to perform their natural functions. This is a basic fact which is universally accepted by physiologists.

3. That the materials of which animals are constructed are specifically adapted to electrical processes. Certain known facts regarding the principal constituents of the body will be cited and new evidence submitted.

4. That in their structure and function the unit cells of the organism are adapted to fabricate, to store, and to discharge electricity. Certain generally accepted facts and certain new evidence which tend to establish this requirement will be offered.

5. That the organism as a whole is a bipolar electric mechanism built on the pattern of the unit cells, the unit cells being constructed on the pattern of the atom. Experimental data which tend to support this requirement will be offered.

6. That the normal and the pathological phenomena of man and animals can be interpreted in electro-chemical terms. Summaries of experimental researches undertaken to establish this point will be given.

THE ELECTRICAL SIGNIFICANCE OF CERTAIN CONSTITUENTS OF THE ANIMAL ORGANISM

Water which forms more than three-fourths of the body content has a high dielectric constant. This property of water is responsible for the ionization of the infinite numbers of molecules which water holds in suspension or in solution. Water is also one of the most important catalysts.

Electrolytic solutions and colloids which make up the bulk of the body are especially adapted to electro-chemical processes.

Hydrogen ions. Hydrogen ions permeate all living organisms. The slightest change in the hydrogen ion concentration fundamentally alters the organism, and hydrogen ions are of high electrical significance.

Carbohydrates are the source of the hydrogen ions which are released by means of *oxidation.*

Lipoid films. Of the highest electric significance are the exquisitely thin, oil films which surround each of the trillions of cells which compose the body. For it is a well known physical fact that an oil film has a remarkable capacity for the accumulation of electric charges and that the thinner the film the higher its electric capacity. While each of the other essential constituents of the organism might play a rôle in an organism operated by some other form of energy, these lipoid membranes are significant only in an organism which is operated by electrical forces.

Nerve cells and nerve fibers. The animal organism as a whole is enmeshed in a network of highly specialized electric conductors—the nervous system. In its physical composition, therefore, the body is not only highly adapted to electrical processes, but its constituents in their various interrelations within the organism could not be of value in a mechanism operated by other forms of energy.

THE UNIT CELL AS AN ELECTRO-CHEMICAL MECHANISM

The unit of structure and of function is the cell. It is essential then to consider the operation of the cell as an electro-chemical unit.

The nucleus of the cell is comparatively acid, the cytoplasm is comparatively alkaline; the nucleus and the cytoplasm are separated by a semi-permeable film of very low conductivity. These characteristics of the cell indicate a difference in electric potential between the nucleus and the cytoplasm.

Thus, we may consider the cell as a bipolar mechanism, the nucleus being the positive element, the cytoplasm the negative element. The oxidation in the nucleus is on a higher scale than the oxidation in the cytoplasm; hence as the electric tension increases in the nucleus, the current breaks through; the potential in the nucleus falls and in consequence the current is interrupted. Since the potential is again immediately restored by oxidation, we conceive that an interrupted current passes continually from the positive nucleus to the negative cytoplasm and in consequence a charge is accumulated on the surface films. These films of infinite thinness and of high dielectric capacity are peculiarly adapted to the storage and adaptive discharge of electric energy.

Why is the infinite thinness of these films of advantage? The work of the cell depends on its capacity for oxidation; oxidation as we believe in turn depends on the difference of potential between the nucleus and cytoplasm; the difference in potential depends on the voltage in the cell; the voltage is in direct ratio to the electric charge the lipoid films will hold; the electric charge the lipoid films will hold is dependent on the thinness of the film—the thinner the film the greater the charge. Dr. Hugo Fricke of the Biophysics Department of the Cleveland Clinic Foundation has found that the film which surrounds the cells is 4/10,000,000 of a centimeter thick; and that this lipoid film has electric capacity of a high order, viz., 0.8 microfarads per square centimeter. We consider, then, that electricity keeps the flame of life burning in the cell; and that the flame (oxidation) supplies the electricity used in operating the animal. In accordance with this conception, therefore, the cell is an automatic mechanism: life, as we view it, is the expression of the activity of this automatic mechanism.

In accordance with this conception, it is of infinite advantage to have the organism made up of trillions of units, called cells, instead of an equal mass in a single unit. The advantage of the enormously great surface area of the lipoid films surrounding the microscopic cells as compared with that of a single cell of equal mass is the corresponding increase in the amount of the electric charge; a corresponding increase in the amount of oxidation; a corresponding increase in working capacity. Sir Arthur Thomson has estimated that there are 28 trillion cells in the human body. On the basis of even as small an average diameter as 20 microns the total surface area of the cells in the whole body would be equivalent to 9 acres. Meynert estimated that there are 1,200 million cells in the cerebral cortex; thus, with an assumed average diameter of 30 microns, the total surface area of the cortical cells of the brain would be 3.36 square meters. On the basis of Dr. Fricke's calculation that the electric capacity of the cell membrane per square centimeter is 0.8 microfarads, this total surface area would have a capacity equivalent to that of a Leyden jar made of glass 0.3 of a millimeter in thickness with a surface area of 114,000 square meters—the area of a city block.

A homely analogy would be a comparison of four surfaces secured for writing by squaring a huge log, as compared with the amount of writing surface secured by converting the log into paper. The crude pattern of nucleus and cytoplasm could be carried out in an animal with a range of activity comparable with that of a glacier—a log instead of a library.

Furthermore, a consideration of the cell as a bipolar electro-chemical unit indicates the dividing line between the living and the non-living. In accordance with this conception, the term "living" applies to the state in which there is an accumulation of electric energy on the membranes with a resultant polarization, together with a mechanism for the release of that energy to perform work. There is no more energy per mass in the living than in the non-living. In the living, energy is captured and stored and made to run the organism; in the non-living the same amount of energy exists, but is balanced, equalized, inert, non-living.

Two streams of water flow swiftly, each seeking the lowest level—equilibrium. One is caught and retarded, thereby building up a potential energy of position as in a mill race; in its further course this retardation is suddenly released and in the discharge of this

acquired potential energy of position a water wheel is turned, and as a consequence of the turning of the wheel, heat, or light, or electricity is generated. The stream which has thus acquired a difference of potential may be said to live, as compared with the undisturbed river, which takes its course unchecked toward complete equilibrium.

Two different metal plates and a suitable solution as separate units are inert, non-living; immerse the plates in the solution and connect them with wires so that a circuit is formed and a current of electricity capable of doing work is created. This corresponds to the energy function of the living.

In other words, the physical energy in the living and in the non-living is essentially the same. In one case the energy is static, in the other it is dynamic. In the one, the difference of potential is produced by means without the mechanism; in the other, the difference is constantly maintained by automatic action within the mechanism itself.

THE BIPOLARISM OF THE MULTICELLULAR ORGANISM

As we have shown, the single cell whether it exists independently as a unicellular organism or as one of the cells of the multicellular organism is a bipolar mechanism, the nucleus being the positive element, the cytoplasm the negative element.

As the nucleus and cytoplasm of the unicellular organs are evolved respectively into an association of trillions of cells, this primary relation between the nucleus and cytoplasm is presumably maintained among these trillions of cells, some groups of which may be considered as "nuclear" cells, because in them is found the highest oxidative capacity; while others, because of their comparatively low oxidative capacity, may be considered as "cytoplasmic" cells. If our conception be true, then among the positive or "nuclear" tissues there must be a tissue of the highest potential of all, and since oxidation determines potential, we are justified, on the basis of experimental researches, in considering that *the brain is the positive pole in the organism.* It remains to give the evidence on which we base our assumption that among the "cytoplasmic" or negative tissues, the liver has the lowest potential—is the negative pole of the organism.

If the brain and the liver are the positive and the negative poles of the organism, then certain conditions would follow from this interrelationship:

1. The brain and the liver would work together; would together show specific changes as the result of work; would together be restored by sleep. This condition has been proved to exist by histological and by physical researches.

2. If the negative pole, the liver, were removed, then the unit cells of the positive pole, the brain, would lose their own potential and the brain would cease to function. This has been proved.

3. Since in their positive-negative relationship the functions of the brain and the liver are antithetic, we would expect that their electric conductivity would vary in opposite directions, and that the temperature changes due to stimulation would vary in opposite directions. Both of these expectations have been realized as has been shown by the findings covering experimental researches elsewhere reported.

4. It is the negative pole that accumulates waste acid by-products and keeps the circuit clear. This is a specific function of the liver.

From these premises we assume that when the great circuit between the liver and the brain is broken, the lipoid membranes, the interfacial surfaces between the colloids, the interfaces in the proteins, etc., no longer receive the electrical charges on which their structure and function depend, and coagulation and death follow. Coagulation follows because the infinitesimal particles making up the colloids are no longer held apart by electrical charges. Although, as we believe, the specific activities of muscles, glands, etc., are carried on by minor circuits, nevertheless, except the grand circuit between the brain and the liver be kept intact and active, life cannot continue. The body as a whole is wired up in innumerable circuits, the unit of which is the nerve cell and its projected nerve fiber.

THE CIRCUIT IN THE ELECTRO-CHEMICAL MECHANISM

As we have already stated, within the unit cells the processes of charging and of discharging follow each other in rapid succession, so that an interrupted current passes between the nucleus and the cytoplasm. Thus, in each of the unit cells of the brain, each cell would fire its charge in a rapid volley through the semi-permeable membranes, the sequence being first an increase in voltage, then a break through the film, a fall in voltage, and an instantaneous rise in voltage at infinitesimal intervals just as is the case in similar apparatus made by man.

Since the membranes of certain cells of the brain are prolonged into highly conductive intercommunicating axons the sum of the charges of many cells may be conducted through their axons past the synapses to the muscles or glands to be stimulated. Through the semi-permeable membranes, however, a part of the current may presumably leak through, and a part of the current may not be consumed in the adaptive response of the muscle or gland. This portion of the current, obeying the universal law which governs the flow from the highest to that of lowest potential, would finally reach the point of lowest potential, the liver, and from thence be conducted back to the brain by means of the electrolytic fluids permeating the organism. The path from the muscles, glands, etc., to the liver may well be over the sympathetic nerves everywhere present in the walls of the blood vessels.

The initiation of the energy transforming impulse in the brain and other nerve cells is due to physical forces in the internal and the external environment, that is, chemical impulses in the internal environment; and in the external environment, the physical impulses of light, heat, contact, and sound waves. These impulses from within or from without initiate the current which passes over one or another portion of a circuit, which includes about twenty-eight trillion electro-chemical units, most of which are self-charging condensers, charged up ready to be discharged by a trigger action, on the arrival of the electric impulse initiated in the circuit by the environmental stimuli. For example, a pattern of white light altered by an object falls on the rods and cones of the eye, which is continuously and in even balance responding to white light. This disturbed balance becomes the adequate stimulus which by a trigger action discharges into the circuit millions of charged condensers. We may suppose that from condenser to condenser a vast accumulating electric charge passes down through the interrupting synapses, driving muscles and glands to action, with consequences which may be commonplace or dramatic. The audion in the wireless, the stepping-up mechanism of the long distance telephone, are but weak imitations of the marvelous augmentation and step-up mechanism which probably operates in the human brain.

Electricity, it would appear, is the thread which binds together in form and function the compound, the solution, the colloid, the cell, the animal.

A THEORETICAL LINE OF DESCENT FROM THE ATOM TO MAN

Have the living cell and the atom a similar physical pattern of structure; and a similar arrangement of their physical forces; in each is the internal stress as well as the internal balance similarly staged? Is it possible to identify a law which governs alike inorganic and organic evolution and points the line of descent from the atom to man?

An evenly *balanced* atom such as helium, between whose positive nucleus and two negative electrons there is no unbalance, would go on through all time in complete neutrality neither giving nor receiving energy. But a highly *unbalanced* atom like hydrogen, with its highly positive nucleus only partially balanced or satisfied by its single negative electron, is vigorously attracted to negative atoms. In the hydrogen atom there is a difference in potential in a bipolar unit of the smallest dimensions. This potential energy, unbalance, and this form of bipolarism is probably identical with the unbalance which is the basic condition of life; but it is not life as we know it; perhaps the principal reason being that this bipolar mechanism—the hydrogen atom—is so far beyond the range of our

senses. But if we could place millions of these infinitesimal particles of positive electricity on one side of an exceedingly thin film of ray 4/10,000,000 of a centimeter thick, with negative charges on the opposite side, and if we could adaptively charge and discharge these films in work and function, then in the aggregate we would find the hydrogen atom an essential part of a living organism. A single brick is not a building; but millions of bricks with other material may be arranged into many buildings; so a single hydrogen atom is not a living being, but millions of hydrogen atoms with other elements may be arranged into living beings.

It may be supposed that it is the disturbance in the carbon atom caused by the sun's energy that endows the carbon atom with the energy which in combination with hydrogen it carries with it into the cells of animals where it is released in the electric process of oxidation. Thus, energy available for building living beings or for the use of living beings comes from the sun. Chemical action is identical with electric action, for it is the attraction and the repulsion of unbalanced negative and positive elements that makes compounds, solutions, colloids. If there were no atomic; no intermolecular; no interfacial electric phenomena, there would be no compounds, no solutions, no colloids, no life.

The atom, the compound, the solution, the colloid contain as much energy outside the living cell as within the cell, the difference being that in their existence as separate entities the electric energy is balanced and since no difference in potential is established, there is no free energy such as is seen in, and is characteristic of, the living. In addition to the interatomic, intermolecular, interfacial forces, living organisms require free energy between positive and negative poles which are separated from each other by a sufficient distance so that the current flowing between the poles may release a continuous stream of new energy to perform work. This energy when governed by the environmental forces becomes available for the various forms of work and function needed for survival. A bipolar mechanism with films adapted to receive charges of electricity and to release electricity for the oxidation required to meet the needs of survival is a living thing.

It is not necessary that the negative or cytoplasmic part of the cell should be continuous or that it should be bound only to one nucleus. For example, Kofoid and others have shown that in certain unicellular organisms there may be one continuous cytoplasm with many nuclei of varying size and shape. This is a crucial point in a consideration of the descent of living matter, for on this basis we can see how an infinite amount of negative colloids forming the fertile part of the earth—in seawater, mud, soil—might be looked upon as a vast negative area or cytoplasm; and infinite masses of positive colloids, each surrounded by thin films with a high oxidative capacity might well be considered as positive nuclei.

These positive nuclei we may regard as bacteria. A bacterium might thus be regarded as a first "step-up" from the uniform colloid, occupying together with millions of other like positive nuclei (bacteria) a common cytoplasm—seawater, soil, mud, etc. If this conception were correct, then we would expect to find that bacteria (nuclei) would stain like the nuclei of cells; and so they do. Since bacteria (nuclei) depend for their existence on a difference in potential between them and their cytoplasm, we would expect to find that bacteria are sensitive to the hydrogen ion concentration of the media; and this is so. For the same reason we would not expect that bacteria could successfully compete for energy—life—with the nuclei of cells; bacteria are rarely found in the nuclei of cells. Bacteria, then, in terms of physics, are multiple positive nuclei, occupying in common a continuous negative cytoplasm.

By a fortuitous circumstance, a bacterium, surrounded by a wider secondary film, might at some moment have acquired for itself some of the cytoplasm or negative colloid which it had shared with all the other bacteria and so it would have become independent of the common supply of negative colloids or cytoplasm and would have become the first independent electro-chemical mechanism, both of whose poles were separated from the common surroundings; that is, it would have become a cell.

Thus, according to our theory, living cells are self-charging condensers built on the fundamental pattern of the atom, and animals in turn are developed into the larger, more complicated forms by progressive additions of these electro-chemical units.

AN ELECTRO-CHEMICAL INTERPRETATION OF NORMAL AND PATHOLOGICAL PHENOMENA

If the electro-chemical theory is correct, then it must interpret the abnormal as well as the normal phenomena of animals and man. Thus, it must interpret in electro-chemical terms such major phenomena as the emotions, physical exertion, etc. It must interpret the effect of physical and chemical injury; the effect of want of oxygen; of want of water; the effect of too much, no less than that of too little heat; the defense against bacteria; the process of healing of wounds; the effects of anæsthetics, and of the various drugs; the phenomena of hyperthyroidism and of thyroid deficiency; the phenomena of excessive adrenal activity and of adrenal insufficiency.

It must interpret the difference in physical mechanism between a fertilized and a non-fertilized cell, between a cancer and a normal cell; it must show the mechanism of stimulation and of depression; it must interpret shock, exhaustion and death; it must interpret sleep and restoration. While all of these interpretations have not been made as yet, the data thus far accumulated present such uniformly supporting evidence that we believe that the basic evidence whereby to interpret most if not all of the phenomena of life, will ultimately be secured.

Since electric conductivity and the production of heat are basic phenomena in the operation of an electro-chemical mechanism, we have tested the theory by measurements of changes in electric conductivity and of heat production in various organs and parts of the body. In accordance with the electro-chemical theory we would expect:

1. That the electric conductivity of cells would vary with stimulation and depression.

2. That the conductivity of the part of highest potential (the brain) and the conductivity of the part of lowest potential (the liver) would vary in opposite directions.

3. That physical or emotional excitation; excitation produced by the intravenous injection of adrenalin, by physiologic doses of iodine, or of thyroid extract, or the injection of strychnine, would show in the brain an increased conductivity in the stage of excitation and a diminished conductivity in the stage of fatigue; and antithetic effects in the liver.

4. That ether anæsthesia in its early or excitant stage would show an increased conductivity, and in the depressant or anæsthetic stage a diminished conductivity of the brain.

5. That morphine would minimize or prevent changes in electric conductivity as the result of adrenalin; of infection; of physical injury; of emotional excitation.

6. That the excision of the liver or of the adrenals would decrease the conductivity of the brain.

7. That prolonged consciousness carried to the state of fatigue would decrease the conductivity of the brain and that sleep would restore the normal conductivity.

8. That the actively multiplying cancer cells would show a higher conductivity than the normal cells of the tissue in which they arose; that the central autolyzing, non-growing part of a cancer would have a lower conductivity than the aggressively growing margin of the cancer; that such pre-cancerous tissues as X-ray scars, adenomata or fibroid tumors would have a conductivity higher than normal.

9. That such mediating fluids as blood, cerebrospinal fluid, and bile would have a high conductivity.

All of these expectations have been realized by the test of electric conductivity measurements.

Having found that the changes in electric conductivity were consistent with the electro-chemical theory, we then by means of accurate and sensitive thermocouples made simultaneous observations of the temperature changes in the various organs and tissues that might be concerned in energy transformation under the same normal and pathologic conditions as those studied in the foregoing conductivity experiments.

Since, according to our theory, oxidation is the source of the difference in potential; and

since heat is a constant by-product of oxidation, we would expect to find that the temperature of the brain would be increased by stimulants and decreased by depressants.

We would expect to find that stimulation would produce opposite effects upon the temperature of the brain and of the liver and other relatively negative organs. Upon testing these assumptions we found that the temperature of the brain was increased and that of the liver and other negative organs was decreased or unchanged in the acute stage of stimulation by emotion, by physical injury, by strychnine injection, by the injection of adrenalin, when the output of adrenalin was artificially increased by asphyxia, in the excitant stage of ether anæsthesia.

On the other hand, if we were correct in our assumption that the liver is the center of negativity and is essential to keeping the circuit in the bipolar mechanism free from chemical by-products, then if the liver were removed, we would expect that the circuit in the bipolar mechanism would become progressively interfered with, and would finally be completely blocked with the resultant establishment of equilibrium or death. We found by experiment that when the great circuit which energizes the organism was broken by the removal of the negative pole, the liver, the temperature of the brain steadily fell until death occurred; also that, when stimulants such as adrenalin were given, heat production (oxidation) within the brain bereft of its negative pole was almost or entirely prevented.

Again, in accordance with the bipolar theory, we would expect to find a steady fall in the temperature of the brain when the semi-permeable films around the cells, the charges upon which govern oxidation, were rendered less permeable. We found that in the state of deep ether anæsthesia which lessens the permeability of these films and hence interferes with oxidation, the temperature of the brain and of the liver fell steadily until death occurred.

On the other hand, we found that in nitrous oxide anæsthesia, which interferes with oxidation itself, but does not interfere with the permeability of the lipoid films surrounding the cells, the temperature of the brain decreased much more slowly.

We found also that sodium, which increases permeability, and calcium, which decreases permeability, having opposite physical effects, had opposite effects on the temperature of the brain, which was increased by sodium, and decreased by calcium.

We expected to find that in strychnine convulsions we would see violent changes in the temperature of the brain and the liver; and our expectation was realized.

Since morphine stabilizes the organism; since one of the clinical effects of morphine is the elimination of emotion; and since the emotions probably excite the adrenals to increased activity (Cannon), we expected to find that if an animal were first deeply narcotized with morphine, then given adrenalin, the morphine would interfere with the great change in the temperature of the brain which is produced by adrenalin in normal animals; and our expectation was realized.

Since certain lethal agencies such as the cyanides produce a phase of excitation followed by depression we expected to find a brief temperature rise followed by a dramatic fall; and our expectation was realized.

Since the intravenous injection of adrenalin causes increased oxidation, and since asphyxia causes an increased output of adrenalin, then if an animal were asphyxiated, we expected that the consequent increase in the output of adrenalin would increase the temperature of the brain; and our expectation was realized.

On the other hand, if both adrenal glands were first removed, then asphyxia could produce no increase in adrenalin, and in consequence we expected that in an adrenalectomized animal asphyxia would not cause any increase in the temperature of the brain; and our expectation was realized.

The first effect of a lively hæmorrhage is to call out an emergency increase in adrenalin (Cannon). We therefore expected that in an acute hæmorrhage the temperature of the brain would show a temporary rise; and our expectation was realized.

These observations on so fundamental a group of facts as the expected variations in temperature and electric conductivity run

parallel with another great group of observations which are just as fundamental, but have a much larger chance of error. I refer to the microscopic changes in the size and in the differential stainability of the cells of the leading organs of the body in excitation and fatigue. These carefully studied changes in the cells suggested the electro-chemical theory. In these experiments we found that vital function varied with the differential stainability of the cells of the brain and of the liver and to a lesser degree of the cells of the adrenal cortex. If the acid-alkali stain of the nucleus and of the cytoplasm respectively is a measure of the respective intensities of the acid or nuclear part, and of the alkaline or cytoplasmic part; and if the energy of the organism is dependent on the difference in potential and the difference in potential is due to the relative acidity and alkalinity, then the cytologic studies by Dr. Austin, Dr. Hitchings, and myself are strongly corroborative of the electro-chemical or bipolar theory.

A SUGGESTION AS TO THE ELECTRO-CHEMICAL BASIS OF REPRODUCTION

It is a universal law of nature, first stated by Cohnheim, that cells alone can produce cells. If oxidation in the cells is due to the electric potential, and if oxidation and the film condenser are essential to life, then we can see that the potential can be handed on only by a division of the cell; the division of the cell including a division of the mechanism which creates the potential in such a way as to provide in each new cell a difference in potential; i.e., the "flame" of life must be handed on from cell to cell. Thus, we may conceive that when the spermatozoon which is essentialiy a nuclear structure is added to the nucleus of the ovum, a greatly augmented nucleus is formed with a corresponding increase in oxidative capacity; hence a capacity for attracting and using food, increasing in size, and in consequence multiplying by cell division.

AN ELECTRO-CHEMICAL CONCEPTION OF THE DEVELOPMENT OF CANCER

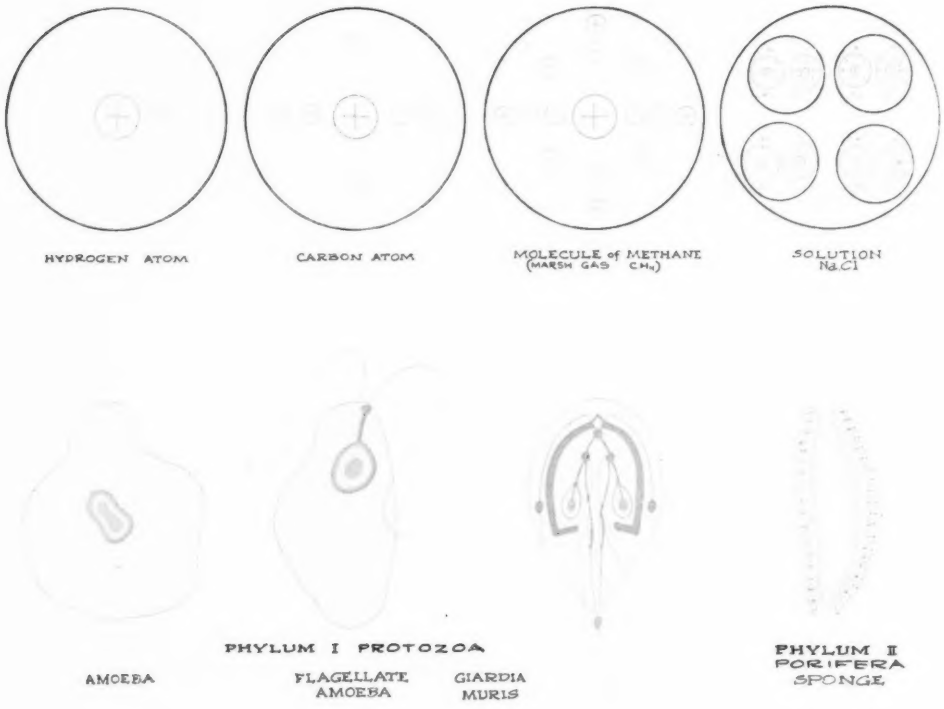
By analogy we may conceive that the facilitation of cell division in cancer, in some way as yet unknown, depends upon an addition to the oxidative or nuclear part of the cell. Such an increase in oxidative capacity would add to the bulk of the cell, just as the increase of oxidative capacity in fertilization increases the size of the ovum. By the division of both the nucleus and the cytoplasm, the relatively high electric potential would be handed on to the daughter cells, in which in turn the potential would be correspondingly high, and thus the process would become progressive at the expense of the cytoplasm of the neighboring cells. Thus, in the case of a group of cells which have been injured by repeated slight trauma, or by irritation of any kind, so that the cells are alternately injured and repaired, we may suppose that one cell may have become fused with another, or that by some other means the oxidative capacity of the nucleus has been increased, with a resultant increased size of the nucleus and hence increased potential. This cell would then multiply at the expense of its neighbors and a cancer would develop.

THE ELECTRO-CHEMICAL RÔLE OF SLEEP

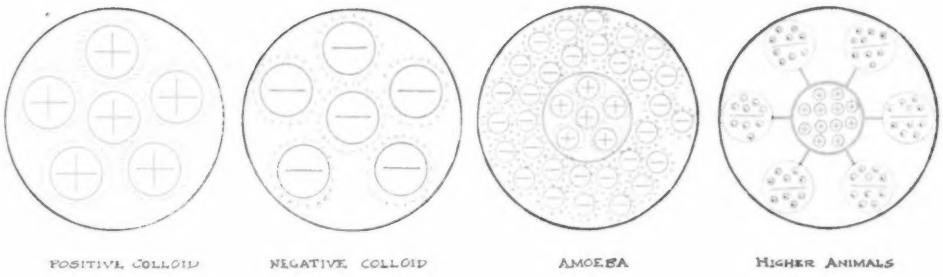
If a battery is made to work continuously by keeping its circuit closed, polarization of the plates will take place and the battery is said to be exhausted, which means that the difference of potential has diminished or disappeared. It would appear to be more than a mere analogy that prolonged consciousness unbroken by sleep leads to exhaustion and death.

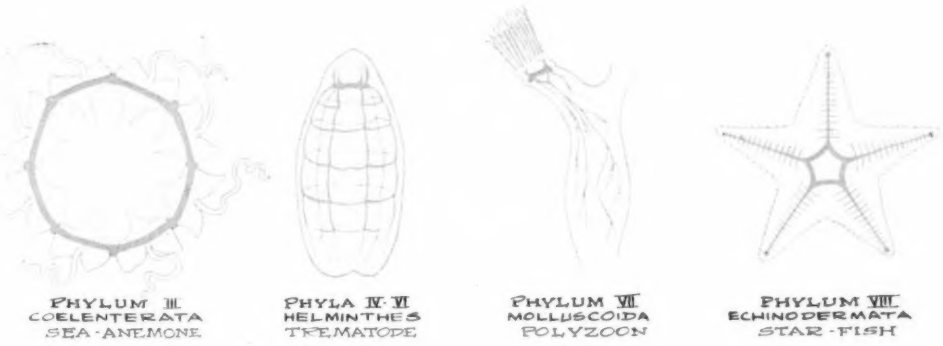
If the period of work—i.e., if the passage of electric current is short, as in a single heart-beat, then the degree of polarization is *proportionately small*. The small degree of polarization which results from a single heart-beat requires a proportionately short time for repolarization or sleep—i.e., the pause in the heart cycle may be regarded as its period of sleep. The heart, with its nerve mechanism, takes normally from seventy to ninety naps a minute and thus is kept polarized or rested as it works.

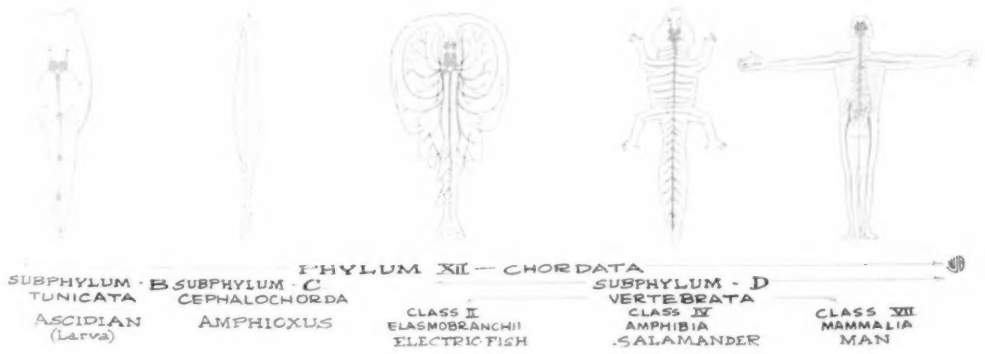
We may suppose that the nerve cells which operate the respiratory mechanism become polarized, or sleep, from sixteen to eighteen times per minute, and that thus the respira-



Drawing showing theoretical descent from atom to man, the red showing the positive (nuclear) elements, the blue, the negative (cytoplasmic) elements.







Drawing showing theoretical descent from atom to man, the red showing the positive (nuclear) elements, the blue, the negative (cytoplasmic) elements.

tory mechanism is kept polarized or rested as it operates.

The salivary glands, the intestinal nerve-muscle mechanism, the digestive glands, etc., we may suppose, have alternating periods of *work and polarization*, and of *sleep and re-polarization*. Regarded superficially, the functions of respiration, of circulation, of digestion, carry on as if they never rested, never slept; but their sum total of short periods of sleep is quite as large as the total period of sleep of that part of the brain whose work creates consciousness, and therefore spends no more time in sleep, but sleeps more conspicuously.

As for the portion of the brain which governs conscious activity, the periods of work, and therefore of polarization of the cells that supply the electric power for consciousness, for emotion, and for muscular action, are longer than the periods of work demanded by the heart, by the respiratory mechanism or by the digestive mechanism. Thus, the option of evolution apparently has been to run the organism on long shifts or shorter ones.

If the changes in the nerve cells seen in fatigue from various kinds of work and from prolonged enforced consciousness are identical in appearance; if these physical changes are restored only during sleep; and if the degree of cell change varies with the amount of work done at a stretch without sleep, that is, with the amount of electric energy that has originated in or traversed a given cell, then it would require more time and deeper sleep to restore the electrical balance of the cell after prolonged heavy muscular exertion than after a day of restful quiet. And this is demonstrated by experience. It would appear that the degree of exhaustion equals the protraction of consciousness multiplied by its intensity.

Sleep, being a negative phase, cannot be *compelled*. Consciousness, being a positive phase, can be *compelled—even unto death*. Normal man cannot sleep unto death; he can sleep only to restoration—no more.

THE RELATIONSHIP OF THE ELECTRO-CHEMICAL THEORY TO SURGICAL MORTALITY

If the electro-chemical theory is correct then it must stand the crucial test of the clinic not only in the interpretation of pathological processes but also in the indication of methods of conservation and restoration. If the operation of the organism can be interpreted by the laws of physics, then methods for the protection and restoration of the organism should be dictated by the same laws. For the optimum operation of the electro-chemical organism, the maintenance of an optimum difference of potential, the following conditions are essential:

1. An abundant supply of water.
2. An abundant supply of oxygen delivered to the cells.
3. Maintenance of the semi-permeability of the lipoid cell membranes.
4. Maintenance of an optimum temperature.
5. Maintenance of the integrity of the poles of the organism, that is, of the cells in the brain and the liver.
6. Sufficiently long and sufficiently frequent periods of sleep.

The practical application of these principles in the treatment of the "bad risk" patient may be briefly outlined as follows:

1. Water is given in abundance by every route; 2,000 to 4,000 cubic centimeters or more given by hypodermoclysis most quickly reaches the cells.

2. Oxidation is promoted by the maintenance of an adequate circulation; by transfusion if the volume is below normal; and by digitalization to strengthen the myocardium, if the minute volume is diminished by a weakened myocardium.

3. The semi-permeability of the cell membranes is conserved by the avoidance of ether anæsthesia and the employment of nitrous oxide-oxygen analgesia—*not anæsthesia*—plus local anæsthesia.

4. An optimum temperature is secured by the obvious measures indicated by the needs of the individual case. Of peculiar value are large hot packs over exposed abdominal viscera. The administration of hot fluids by mouth not only supplies local heat and water but, as experiments have shown, its effects are instantly manifested by increased oxidation in the brain.

5. The integrity of the brain and the liver is kept from further damage by environ-

mental control; by the infliction of minimum trauma; by performing the operation in the patient's room; and above all by securing adequate sleep and rest. The protective effect of morphine in particular is needed, and when that is contra-indicated other narcotics and sedatives should be utilized to promote the needed periods of repolarization. The necessity is the maintenance of a difference in potential—this is the maintenance of life.

Just as no two man-made electric mechanisms require exactly the same combination of methods for repair, so the treatment of the human electric mechanism must be individualized; and since we desire to conserve as well as restore, these measures should be employed in advance of the emergency.

Since the initiation of this plan of treatment formulated in accordance with physical laws, our surgical mortality and our surgical morbidity have been progressively decreased. In 14,949 operations performed at Lakeside Hospital during the last three and one-half years the surgical mortality has been 1.8 per cent; in all operations performed during 1922 the mortality was 1.6 per cent. In operations for acute abdominal conditions—gastro-enterostomy and resection of the stomach, cholecystectomy and cholecystostomy, colostomy and resection of the large intestine, and operations for acute appendicitis, the mortality has been 3.8 per cent. In this group are included 141 operations for cancer of the large intestine including 51 resections, with a mortality of 2.8 per cent.

Perhaps in no other group of cases has the validity of the biophysical interpretation of physiological processes been more strikingly demonstrated than in the results of operations on the thyroid gland. Thus, in our last 500 thyroidectomies there has been a mortality of 0.6 per cent; in our last 500 ligations there has been a mortality of 0.4 per cent; and in our last 720 operations upon patients with hyperthyroidism, in whom the condition was so acute that the operation was performed in the patient's room, the mortality has been 1.2 per cent. In the last 1,000 thyroidectomies for hyperthyroidism performed in the operating room as well as in the patient's room, the mortality has been 0.8 per cent.

CONCLUSIONS

Although the electro-chemical theory interprets well the normal and the pathological phenomena of man and animals; although the numerous predictions based upon this theory were established by the more exact methods of physics; although it has furnished a plausible suggestion as to the line of evolution from the atom to man; although the theory has stood the crucial test of the surgical clinic by providing a scheme of management which has produced the shockless operation—the theory is not yet proven, and will not be proven until the equivalent of a living cell is constructed; until the equivalent of life is artificially made.

Nevertheless, from previously accepted facts, from clinical observations, and from the evidence of experimental researches in our laboratory of biophysics we conclude:—

1. That electric phenomena are co-existent with living phenomena because electricity is detected in every living plant or animal and is absent in the dead;
2. That electricity is manifested in every act of the living and is probably the so-called "spark of life";
3. That there are great numbers of different kinds of electric circuits in animals;
4. That the source of electricity in the cells is oxidation;
5. That oxidation in the cells of the organism is initiated and governed by electricity;
6. That electricity is accumulated on the lipoid films of the trillions of cells;
7. That each of the trillions of cells is a diminutive electro-chemical unit;
8. That during life there is a difference of potential, a state of unbalance within the organism;
9. That death is equilibrium of potential;
10. That there is a universal pattern of the living in the form of bipolarism;
11. That in the non-living no less than the living exists the universal pattern of bipolarism;
12. That the pattern of bipolarism runs in continuity from atom to man;
13. That man is an electro-chemical mechanism, a giant amœba climbing up the slippery banks of time.

CHRONIC DUODENAL STENOSIS[1]

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CHRONIC partial stenosis of the duodenum may be due to a number of causes. This paper is limited to a consideration of the form resulting from compression of the bowel between the root of the mesentery (with its contained superior mesenteric artery) and the aorta.

The clinical significance of the anatomical relations of this part of the duodenum was first brought to the attention of the profession generally through the study of the etiology of acute dilatation of the stomach during the last decade of the nineteenth century. That compression by the root of the mesentery is an important, perhaps the most important, factor in the causation of this acute condition is now widely accepted. Its relation, however, to the chronic form of duodenal dilatation has only recently attracted attention and needs further study.

Since January, 1914, when my attention was first directed to the subject, I have examined the duodenum and the root of the mesentery in all clean laparotomies in which the position of the incision permitted and the condition of the patient justified the additional exploration. During these 8 years there was discovered in 26 cases evidence of some degree of obstruction by the root of the mesentery. The operative findings on which this diagnosis was based in these cases were as follows:

1. Dilatation of the duodenum throughout its whole length from the pyloric ring to the point where it is crossed by the superior mesenteric artery. This is readily observed in the supracolic portion which may be so dilated as to lie in contact with the anterior abdominal wall. By drawing up the transverse colon, the third portion of the duodenum may be seen and felt bulging through the lower layer of the transverse mesocolon.

2. Narrowing of the angle between the superior mesenteric artery and the aorta sufficient to obliterate the lumen of the bowel at this point. This is determined by inserting the tip of the index finger from left to right into the angle. A fairly accurate estimation of the size of the angle can thus be made.

3. On elevating the root of the mesentery by the finger, the gas within the duodenum is seen to pass on into the jejunum which was previously collapsed.

4. Palpation of the duodenal wall gave the impression in a few cases of hypertrophy of its musculature.

The degree of dilatation is indicated in my records by the plus sign. Of the 26 cases, eleven are marked +, seven ++ and eight +++. None were classed ++++. The duodenum in the eight marked +++ was a little greater in diameter than the distended transverse colon. With one exception the only cause of the apparent obstruction was compression by the root of the mesentery. In this one case there was, in addition, adhesions between the gall bladder and the descending portion of the duodenum.

The finding of a duodenum not dilated but distended with gas which is evidently prevented from passing on into the empty jejunum by compression of the root of the mesentery, has been, in my experience, much more frequent than the finding of actual dilatation of the bowel. This temporary stasis may be attributed to narrowing of the vascular angle by the dorsal position on the operating table and to suppression of peristalsis by the pre-operative dose of morphine. A continuation of the dorsal position and the morphine after operation, I believe, may be responsible for many cases of acute postoperative dilatation of the stomach.

ANATOMY

In man, as shown by the studies of Dwight and others, the bowel as it lies behind the root of the mesentery is not a cylindrical organ but is flattened to the ovoid form. (Fig. 1.) In the domestic animals, on the other hand, as may be seen by a visit to an abbatoir, this vascular angle is wide and, the bowel being free from compression, retains the cylindrical form. It may be noted, also, that in all the

[1] Read at meeting of Manitoba Section of American College of Surgeons, September, 1922.

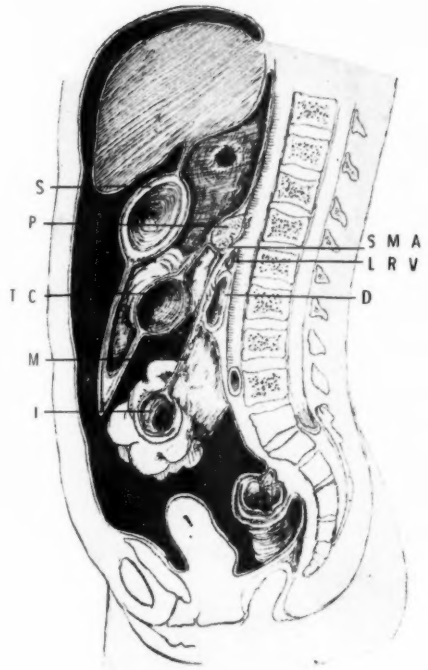

Fig. 1. Transverse section of the normal duodenum (Modified from Gray's *Anatomy*.) s, Stomach; p, pancreas; t.c., transverse colon; m, mesentery; i, ileum; s.m.a., superior mesenteric artery; l.r.v., left renal vein; d, duodenum.

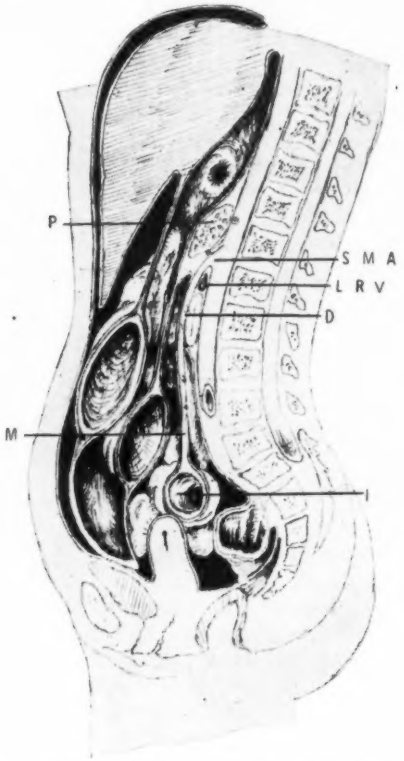

Fig. 2. Drawing showing compression of the duodenum in the enteroptotic female. p, Pancreas; m, mesentery; i, ileum; s.m.a., superior mesenteric artery; l.r.v., left renal vein; d, duodenum.

well-known quadrupeds the anteroposterior diameter of the body in its middle zone is greater than the transverse diameter, while in the human, the transverse diameter is the greater; and, in individuals of the enteroptotic figure, the disparity between these diameters is usually most marked. It is evident that the greater the divergence from the form of body seen in quadrupeds, the greater will be the acuity of the vascular angle, and the more marked the flattening of the duodenum. In the virginal type of enteroptosis the superior mesenteric artery may be found in its upper portion, lying very close to the aorta (Fig. 2). The anatomical relations of the structures in this region suit the postures assumed by the lower animals but are not well adapted to either the erect or dorsal postures assumed only by the human. Duodenal compression by the root of the mesentery occurs only in the human, and is clearly one of the many disabilities resulting from the assumption of the erect posture. It is evident also that the habit, still prevalent, of keeping the patient on the back for from 24 to 48 hours after operation, without special reason, is likely to lead occasionally to trouble. The normal individual never voluntarily maintains the dorsal for more than a few hours.

It is a reasonable inference that individuals presenting the above laparatomy findings have, while in the erect or dorsal position, a duodenal outlet so compressed as to amount to a chronic partial obstruction. To overcome this obstruction undue peristaltic effort is required, resulting, at first, in compensatory

hypertrophy of the musculature, followed later, when this fails, by dilatation of the duodenum. The "writhing duodenum" described by roentgenologists and the increased thickness of the duodenal wall noted in some of my cases support this view.

The frequent association of visceral ptosis with arteriomesenteric obstruction has been noted in most of the papers published upon this subject. In 19 of my 26 cases, ptosis of the cæcum and right half of the colon was present. Of the 7 remaining cases, which were free from visceral ptosis, two had adhesions of the ileum to structures in the pelvis. In 5 nothing was found to account for the evident drag upon the root of the mesentery. Dilatation of the stomach with a wideopen pylorus was present in nearly half, but gastroptosis, without dilatation, is recorded as occurring once only in these 26 cases. On the other hand, in 5 cases of extreme prolapse of the stomach, occurring in individuals with the virginal type of visceral ptosis, laparatomy disclosed a normal duodenum in every case. My experience, therefore, supports the view that, at most, gastroptosis is only a minor factor, and, that a loose cæcum, with an elongated parietocolic fold, getting its support from the mesentery of the small bowel, is the most important cause of mesenteric compression of the duodenum.

The functions of the duodenum are only imperfectly known. It has been amply established, however, both experimentally and clinically, that complete obstruction to the onward flow of its contents leads to a rapidly fatal issue with symptoms of profound toxæmia. That chronic partial obstruction may also result in the formation of the toxic substance, or reflexly interfere with functions of liver and pancreas, with symptoms of chronic toxæmia, seems highly probable.

DIAGNOSIS

Chronic duodenal obstruction must be added to the list of conditions underlying "chronic dyspepsia," once regarded as "the prevailing malady of civilized life." The dyspepsia associated with it presents no distinctive features and a definite diagnosis from the clinical history, alone, cannot be made. Symptoms of a chronic toxæmia, particularly headaches relieved by vomiting of bile, the so-called bilious attacks, when occurring in individuals, the subjects of visceroptosis, are most significant. Chronic disease of appendix or gall bladder was the pre-operative diagnosis in the majority of my cases, and usually disease of these structures was found along with duodenal dilatation. Indeed, the presence of chronic multiple abdominal lesions is the rule in the type of individual subject to mesenteric occlusion of the duodenum. Another significant feature is the relief from gas and the feeling of distention afforded by assuming the lateroprone position after meals, especially if this is preceded by the knee-chest position for a few minutes. I have found palpation and percussion of little help in trying to detect a distended duodenum. Roentgenological examination is the most important diagnostic means, and in the hands of an expert will definitely determine whether or not duodenal stasis is present.

TREATMENT

1. *Non-operative treatment* consists in the use of corsets and abdominal belts designed to support the prolapsed viscera. This always affords a measure of relief. In the acquired type of visceral ptosis, the relief is usually complete so long as the support continues efficient. It is well known that pregnancy relieves the symptoms of visceral ptosis. In 1909 during operation for appendicitis upon a young woman, her duodenum was observed to be dilated. She had the enteroptotic figure in marked degree, and, since puberty, had been subject to digestive disturbances with periodical "bilious spells." These symptoms were not relieved by the removal of the diseased appendix (no other operation was done), and very slightly by the use of a well-fitting corset. She married and during the latter half of each of her five pregnancies she has been quite free from symptoms but during the intervals between pregnancies suffered as before. X-ray examination, 1920, showed duodenal stasis present in marked degree. In such cases (and they are not uncommon), is the relief due solely to the support afforded by the pregnant uterus, or is a change in the internal secre-

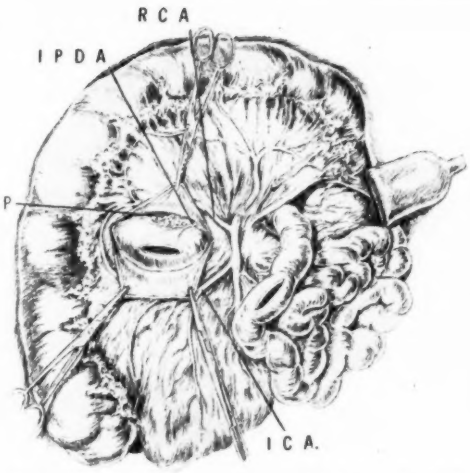

Fig. 3. The duodenum is exposed between the right colic and ileocolic arteries. r.c.a., Right colic artery; i.c.a. ileocolic artery; p, pancreas; i.p.d.a. inferior pancreaticoduodenal artery.

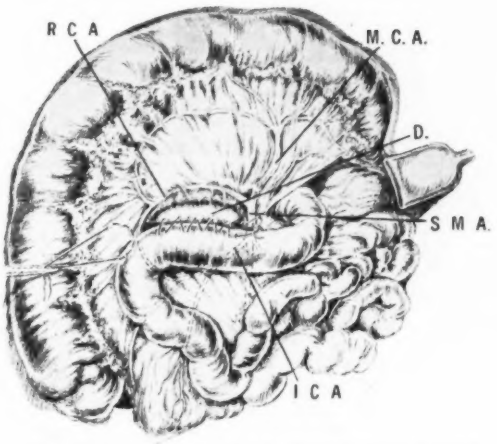

Fig. 4. An additional stitch is placed to prevent angulation. r.c.a., Right colic artery; i.c.a., ileocolic artery; m.c.a., middle colic artery; d, dilated duodenum; s.m.a., superior mesenteric artery.

tions also a factor? As the relief does not come until the uterus is large enough to fill the pelvis, the mechanical factor seems to be, if not the only one, at least the most important.

Posture. Inasmuch as chronic cases are rarely confined to bed, postural treatment has a limited application. It is especially useful in the prevention of postoperative acute dilatation. The patient with the above operative findings should be early changed from dorsal to lateral position, even at the cost of temporarily increasing his discomfort. The incidence of acute dilatation of the stomach will thereby be decreased. In carrying out the "rest cure" in individuals, with this type of body form, the possible injurious effect of the prolonged dorsal posture should be remembered.

2. *Operative treatment.* a. Gastro-enterostomy was the first operation tried for the cure of duodenal obstruction. The results, in the considerable number of cases now recorded, have, with few exceptions, been quite unsatisfactory. In those cases in which the pyloric ring is dilated and incompetent, permitting duodenal contents to regurgitate into the stomach, some benefit will accrue. In important papers recently published, Hartmann (2), Wilkie (3), and the Kelloggs (4) express the view that the operation is unsuitable and that the indications are best met by anastomosis between duodenum and jejunum below the transverse colon.

b. Duodenojejunostomy was first suggested by Professor Barker (5) in discussing a paper read by Dr. Finney on duodenal obstruction at a meeting of the Johns Hopkins Medical Society in November, 1905; and it was first performed by Dr. A. W. Stavely in December 1907 (6). There is no record in the literature of Stavely's operation having been again resorted to until it was performed by the writer (7) in January, 1914. Now, there are more than sixty published cases, most of them reported during the past 3 years. This indicates how recent is the interest in the subject. The Kelloggs report 41 duodenojejunostomies, 30 of which were done for this form of duodenal obstruction (8).

In 13 of my 26 cases this operation was performed, the last one January, 1922, and the first one 8 years previously. An analysis of these 13 cases is given in the accompanying table. In all except one (Case 10) other operations were also performed at the same time.

There was one operative fatality: In case 9 death was caused by intestinal obstruction from angulation at site of anastomosis. A

ANALYSIS OF 13 CASES IN WHICH DUODENOJEJUNOSTOMY WAS PERFORMED

Case	Sex	Age	Clinical diagnosis	Bilious attacks	Viscero-ptosis	Operative findings	Duodenal dilatation	Operations performed in addition to duodeno-jejunostomy	End-results
1	F	32	Duodenal ulcer	+++	o	Chronic appendicitis	+++	Appendectomy	Well till Dec., 1919; 6 years after operation; then gall-bladder symptoms
2	F	23	Chronic appendicitis		++	Chronic appendicitis	++	Appendectomy	Well for 2 years; died of p.t.b. 5½ years after operation
3	M	27	Chronic appendicitis	+++	++	Chronic appendicitis	++	Appendectomy	Well 4 mos. after operation; unable to trace since then
4	F	35	Duodenal stasis	o	+++	Chronic appendicitis, cæcum lying upon the bladder	+++	Appendectomy; cæcocolopexy	Well, now 5 years since operation
5	M	30	Chronic appendicitis; duodenal stasis		++	Adherent appendix	+++	Appendectomy	Well
6	F	31	Cholecystitis, duodenal stasis, floating kidney	+++	+++	Chronic appendicitis and cholecystitis, right coloptosis	+++	Appendectomy, cholecystectomy; nephropexy	Much improved but still has bilious attacks
7	F	29	Chronic appendicitis	o	++	Adherent appendix, mobile cæcum	++	Appendectomy	Well
8	M	20	Duodenal stasis, dilated stomach		+++	Stomach dilated; pyloric ring dilated; cæcum prolapsed; appendix negative	++	Appendectomy, gastropexy (Beyea)	Well
9	F	59	Gall bladder hernia	o	o	Gall bladder adherent to duodenum; omentocele	++	Cholecystectomy; repair of hernia from within	Died on 4th day from obstruction due to angulation at site of anastomosis
10	F	54	Chronic cholecystitis	+++	++	Gall bladder and appendix negative; stomach and duodenum dilated	++	None	Slight improvement in digestive symptoms
11	F	33	Chronic appendicitis	++	+++	Adherent appendix; stomach dilated and prolapsed; cæcum mobile	+++	Appendectomy	"In better health than for 20 years"—gain in weight 112 to 136
12	F	39	Chronic cholecystitis and chronic appendicitis	+++	o	Appendix adherent and thickened; gall bladder adherent, contained stones	+++	Appendectomy	Much improved
13	M	29	Chronic appendicitis, chronic cholecystitis	o	+	Appendix adherent; gall bladder negative; stomach duodenum dilated	++	Appendectomy	Well

cholecystectomy and a herniotomy were done at the same time, but the fatality was due to a complication of the duodenojejunostomy and must be debited against this operation. All cases reported to date have recovered from operation.

The end-results of the 12 operative recoveries show 9 cured (one of these died of pulmonary tuberculosis 5½ years after the operation); 2 much improved; and in 1 (Case 10) in which duodenojejunostomy was the only operation performed, the result is unsatisfactory.

In doing a duodenojejunostomy, the duodenum is exposed between the right colic and ileocolic arteries (Fig. 3). The mobilization necessary for the application of a clamp can be effected most easily by separating the bowel from below and behind where it is attached by loose areolar tissue to the large vessels and the vertebral column. It is maintained in the intraperitoneal position by suturing the margin of the incised peritoneum to the sides of the exposed segment of bowel. The anastomosis is then made in the usual manner. Since the fatality from angulation occurred, an additional stitch has been placed (Fig. 4) designed to prevent this complication.

c. Suspension of the cæcum. Bloodgood pointed out that the loaded prolapsed cæcum exerts a pull upon the root of the mesentery "when the last portion of the ileum has an

unusually short mesentery." This can be determined during a laparatomy by placing a finger behind the superior mesenteric artery and observing the effect of alternately elevating and depressing the cæcum. In some cases the test is not easily made and the result will be in doubt. In 19 of the 26 cases of duodenal dilatation, it is recorded as positive. I have accepted a definitely positive finding as an indication for suspension of the cæcum. In 13 of the 26 cases this was the only operation done for the relief of the duodenal obstruction. The end-result has been obtained in only 9 of these. Six are cured and three are no better. The operation performed consisted in reefing the elongated parietocolic fold by linen sutures, suspending, but not fixing, the bowel.

CONCLUSIONS

1. The position of the distal portion of the duodenum behind the root of the mesentery is not well suited to either the erect or dorsal posture.

2. As a consequence of compression at this point, duodenal stasis, of degree sufficient to give rise to symptoms, results and constitutes a definite clinicopathological entity, of more common occurrence than symptom-producing nephroptosis.

3. The drag upon the mesentery of the small intestines by a loose cæcum prolapsed into the pelvis is, by far, the most common cause. This drag can usually be determined at operation by the test described above; it may also result from adhesions of the mesentery to structures in the pelvis. Gastroptosis is probably only a minor factor.

4. Suspension of cæcum, ascending colon and hepatic flexure adequately meets the indications and gives satisfactory results in the great majority of cases.

5. Duodenojejunostomy should be restricted to the more extreme cases of dilatation and to those in which the cause of the mesenteric compression cannot be discovered and removed. In my practice, it is being performed much less frequently than formerly, as the comparatively minor suspension operation has proven satisfactory.

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PREMATURE SEPARATION OF NORMALLY IMPLANTED PLACENTA

A Brief Review of the Literature and Reports of Several Illustrative Cases

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ALTHOUGH this rare obstetrical accident was reported as far back as 1603 by a certain Frenchman, to Rigby, in 1776, is due the credit for the first satisfactory differential diagnosis between antepartum hæmorrhage due to placenta prævia, and premature separation of the normally implanted placenta. During the years that followed, a large number of men reported cases, all dealing with frank or concealed hæmorrhage. This type of hæmorrhage is termed by some, abruptio placenta, uteroplacental apoplexy; by Holmes, ablatio placentæ; and by many, premature separation of the normally implanted placenta. The last, I think, is most descriptive.

OCCURRENCE

One of the early writers, from observation of a series of his own cases, has stated that antepartum hæmorrhage is more often this type of hæmorrhage than that caused by placenta prævia by the ratio of 17 to 14. Other writers have found it to occur in one case out of every 156, 216, 513, 612 cases, respectively. Holmes in a recent report, says that it occurs as a pathological entity in one out of every 200 cases, and, clinically, in one out of every 500 cases.

ETIOLOGY

Early writers were inclined toward a theory that traumatism in such forms as extra exertion, direct blows on the abdomen, tortion of the uterus, falls, etc., were the contributing causes to such a condition. Such cases as the the following are illustrations of this theory.

Case 1. Lucius A. Wing reports: A primipara, 28 years old, who had been bleeding for 7 hours before admission. The vagina was packed with gauze. On removal of the packing after admission, no placenta could be felt. Uterine contractions occurred every 4 or 5 minutes. The fetal head presented above the pelvic brim, but did not come into the brim. Abdominal cæsarean section was decided upon. An oval placenta was found; the attachment of the cord was almost marginal at the lower border. The placenta measured 14 by 17 centimeters and the cord was 43 centimeters in length. Two coils of the cord were about the child's neck, and held the head close to the lower border of the placenta. The mother's postpartum course was satisfactory.

Case 2. M. Trillat reports: Para-III; 8½ months pregnant. The patient had driven to the village with her husband. On return, 6 hours later, she complained of fatigue, started to walk; was taken with hæmorrhage, carried home, and thence to hospital. On entrance, the patient was in coma; the fetal heart was not heard; the cervix was dilated 5 centimeters. At touch, the placenta was not felt. The membranes were ruptured artificially. An incision of the cervix with craniotomy was done. The placenta was entirely free and was removed manually without difficulty. There were no gross changes. The opening of the membranes was made 6 centimeters from the placental border. The uterus was not ruptured. A tampon was used to arrest the hæmorrhage. Intravenous and cellular injections were given. The Mom[illegible]g procedure was used as a last resort. The patient expired 17½ hours after the beginning of labor. No autopsy.

The author considers this case a rare form because of the absence of retroplacental hæmatoma or internal hæmorrhage, and because of the presence of the profuse external hæmorrhage.

Case 3. Para-V; age about 35, with onset of labor about one month before term, had been doing hard physical work and had felt no fetal movements for three days before delivery. The delivery was spontaneous after a labor lasting about 10 hours. When the placenta was delivered, about one-fifth of the maternal surface near the margin was much darker and more friable than the remainder. This portion of the surface was covered with an old blood clot. This illustrates the effect of the partial separation of the placenta on the fetus without disturbing the mother. The condition was probably due to traumatism.

Case 4. The patient was admitted to the hospital in labor, October 15. She was delivered spontaneously of a stillborn fetus on the same day. There was a history of miscarriage 5 years ago; one labor 2 years ago. Œdema of the lower extremities had persisted the past 3 weeks. The last menstruation was May 15. The general condition was good; the fetal heart was not heard; there was some albumin in the urine. The placenta was delivered spontaneously and was com-

plete, small, and round, with a dark blood clot on its maternal surface about 5 centimeters in diameter. This represents the occurrence of a small concealed hæmorrhage without serious effect on the mother; but it was probably the cause of the fetal death.

Toxic conditions accompanying pregnancy had never been thought of as having any bearing on antepartum hæmorrhage until cases were reported by Denman in 1807; Braxton Hicks in 1861; Goodell in 1870; Winter in 1885; and a few years later, Holmes in 1901. The 3 following cases show the theories mentioned by the above writers.

Sir William Smyly[1] reports a case of accidental hæmorrhage and contends that a cause of this condition is eclampsia.

CASE 5. Para-III, age 30, previous pregnancies normal. The present pregnancy was normal until the evening before admission, when the patient was seized with abdominal pain. The uterus was hard and tender; no fetal parts were felt; there was no visible hæmorrhage. The urine was scanty and loaded with albumin, casts, some pus, and red blood cells. The abdomen was opened; the uterus was dark, almost blue, with blood extravasation over its surface; and there was free blood in the peritoneal cavity. The placenta was completely detached; the child dead. There was no further hæmorrhage. A good recovery. Urine became free from albumin.

CASE 6. A para-IX, age 39, 36 weeks pregant, was ill about 3 weeks, suffering from headaches and impaired vision. The urine was scanty, bright red, and contained large quantities of blood and tube-casts. The child could be easily palpated. Diagnosis: pre-eclamptic toxæmia. There was twitching of the muscles of the arms. On the fifth day after entrance, there was violent pain in the abdomen; she was pale and collapsed. The skin was cold and clammy, temperature below normal, reddish discharge from vulva. The uterus was hard and tender; the fetus was no longer palpable. The abdomen was opened. The uterus was dark, bluish purple; blood extravasated throughout. The placenta was completely detached, cavity full of blood and clots; fetus dead. The patient gradually revived and made a good recovery, but owing to toxæmic condition was restricted to soda and water for three days. The content of the urine improved and on the fourth day was normal in color and free from albumin.

Most cases of severe accidental hæmorrhage are due to conditions closely allied to and identical with those which cause eclampsia.

CASE 7. M. A. Bonnet-Laborderie reports: Primipara, age 22½. The pregnancy was marked by frequent vomiting from the beginning to the sixth month. Following that period, there was a history of fainting and violent abdominal pains, with an attack in eighth month of unusual violence. Albumin was discovered in the urine. Eclampsia was diagnosed by the local physician, and the patient was sent to the hospital. Auscultation for the fetus was negative. There was no external hæmorrhage. Artificial rupture of the membranes, forced dilatation, and forceps delivery of the dead fetus were done. The detached placenta, between which was a mass of blood clots, was manually expressed. During extraction, voluminous black blood was discharged.

The placenta, disk shaped, presented a flattened surface, literally filled with white infarcts of all forms and dimensions, which appeared most abundant at the border. Albumin disappeared quickly, and the patient left the hospital on the eleventh day.

Two recent cases, delivered in the Evanston Hospital, illustrate this type.

CASE 8. A primipara, age 30, came to Evanston Hospital in the seventh month of pregnancy. The blood pressure was 205–105, albumin was present in the urine, and there was an increase in blood uric acid.

Soon after arrival at the hospital the patient had acute abdominal pain, and faintness, followed by sudden diminution in strength of labor pains. A Voorhees bag was inserted. The uterus was tense and remained so until delivery of baby. Complete dilatation was accomplished in about 6 hours. The second stage lasted 45 minutes. The delivery of a stillborn baby was spontaneous.

Placenta. The placenta showed a large area consisting of three-fourths of its maternal surface occupied by retroplacental clot which was firmly adherent. Only a narrow crescent-shaped area of normal placenta was left.

Diagnosis. Premature separation of the placenta accompanied by an acute toxæmia of pregnancy.

Pathology. The specimen is a placenta 17 by 12.5 by 2.5 centimeters with fetal membranes apparently complete and 46 centimeters of umbilical cord attached. On the maternal surface there is a circle consisting of a ridge of tissue about 1.5 centimeters high surrounding a depressed area in the placental substance, which somewhat resembles a place where the placenta was detached and separated from the uterine wall by a blood clot. Grossly the placenta is normal. The placenta, fetal membranes, and umbilical cord together weigh 308 grams. There is also fluid and clotted blood, said to have been removed with the placenta, weighing 452 grams.

Microscopic sections of this placental tissue reveal thickening of the walls of some of the arteries; otherwise the chorionic villi are normal.

CASE 9. A primipara, age 29, came into Evanston Hospital, March 19, 1913, at term. She had an acute albuminuria, blood pressure 180–105, œdema of ankles and legs, and slight pains with no external hæmorrhage. The first stage lasted 2 hours, the

[1] Dublin J. M. Sc., 1919, cxlvii, 257.

second stage 2½ hours. Low forceps were applied and a living baby delivered.

Diagnosis. Premature separation of the placenta with no external hæmorrhage accompanied by acute toxæmia.

Pathology. The specimen is a placenta 20 by 16.5 by 3 centimeters with fetal membranes complete and 48.5 centimeters of umbilical cord attached. On the maternal surface there are 5 yellow white infarcts 3 to 2 centimeters in diameter, two red infarcts 2 and 2.5 centimeters in diameter; and one hæmorrhage in the placental substance 5 by 4.5 by 3.5 centimeters consisting of a single dark red blood clot. The placenta, fetal membranes, and umbilical cord together weigh 650 grams.

The men quoted all referred to either mild or severe symptoms of toxæmia preceding and accompanying the hæmorrhage, such as albuminuria, casts, rises in blood pressure, œdema, and blurring of vision. In a number of severe cases, in which they found a true eclampsia, the hæmorrhage was fatal. Two cases reported by Cavalaire, the first in 1911 and the second in 1912, were of this type. Essen Moller reported 5 cases of the same type a few years later. Williams, in 1915, reported 20 cases; Ahlstrom, in 1919, 43 cases; Willson, in 1921, 69 cases. These varied from cases of mild toxæmia to cases of severe eclampsia.

AGE AND TIME OF OCCURRENCE

Willson, in 59 cases, the youngest 17 and the oldest 42, finds the average age 32.2 years. In 58 of his cases, the accidental hæmorrhage occurred as follows: 5 cases in the seventh month; 10 cases in the eighth month; 21 cases in the ninth month; 2 cases in the tenth month; and 1 case at a term. Of 67 cases, 26.8 per cent were primiparæ; and 72.2 per cent were multiparæ. In 51 cases the urine showed signs of toxæmia and in only 7 was it normal. In 9 cases in which the blood pressure was recorded, the average pressure was 182.

Accidental hæmorrhage is divided into frank and concealed, but in the great majority of cases of concealed hæmorrhage, there has been seen a slight serosanguinous discharge. Concealed hæmorrhage is best described by a report of cases such as the following:

Case 10. J. Whitridge Williams reports: A primipara; age 24; 7 months pregnant; without previous warning, was seized with intense abdominal pain. There was no sign of beginning labor; the cervix was hard and undilated; there was no vaginal discharge or hæmorrhage. The patient was sent to the hospital; and separation of the placenta was suspected. The patient became sicker and more pallid. Cæsarean section was done. Upon incising the uterus, a stream of clear amniotic fluid escaped under great pressure. A freshly dead seven months' child was extracted, and immediately thereafter the completely detached placenta came into the uterine wound, and upon its removal a large amount of fluid and coagulated blood escaped. The uterus failed to contract, and was removed.

Diagnosis. Premature separation of the normally implanted placenta, concealed hæmorrhage, hæmorrhagic infarction of the uterus, degenerative arterial changes. Recovery.

Case 11. Miles H. Phillips reports: A multipara; age 33; had had nine full time pregnancies, and one miscarriage, with postpartum hæmorrhage on several occasions; antepartum bleeding at last confinement. When about 8½ months pregnant, she awakened in the morning with severe abdominal pain, and fainted. There was no visible bleeding. She was removed to the hospital. On admission, there was pain all over the abdomen, the uterus was large and tense; there was no hæmorrhage from the vagina; the cervix was firm, just admitting two fingers. As soon as the membranes were touched by the gloved hand, a huge gush of blood poured from the vagina. The vagina was packed; blood escaped through the packing. Abdominal section was done. A large quantity of blood and blood-clot came away from the interior of the uterus. The child was as white as the mother. The placenta was found loose on the posterior wall of the fundus, completely separated from the placental site, which was later found to be on the anterior wall. The membranes were intact. The flabby uterus was amputated. There was slow but steady recovery. On the fourteenth day thick white slough projected through the external os; during the next ten days similar pieces of slough presented. The author thinks the sloughs were produced by ischæmic necrosis of lining mucous membrane, and possibly also of part of the muscular wall of the uterine stump. The causation of the antepartum hæmorrhage was not obvious. The placenta appeared healthy, but was not examined microscopically; the child was well developed; there was no albuminuria or other sign of toxæmia; the patient had not met with accident, although she had been working hard.

The frank type of hæmorrhage is best described by the following report of cases.

Case 12. Burnley Lankford reports: A primipara, age 26, with pregnancy normal until about ten days before time labor was predicted. In the morning she began to have slight but steady flow of blood, neither bright red nor yet very dark. The pains recurred at short intervals. The fetal heart was not heard. The cervix was dilated to the size of a quarter; no portion of the placenta was felt. She was sent to the hospital.

Abdominal binder was applied. In the afternoon a dead fetus was delivered, followed immediately by several handsful of dark clots and the placenta. The latter was very interesting. An old, tough, blood clot had practically taken the place of all placental tissue, except immediately around the margin; here there was a ring of normal looking placental tissue, at no point more than an inch wide, and at several points much narrower. When the clot was separated from its bed, which was done with some difficulty as it was so firmly adherent, there was nothing of placental tissue found beneath it, but the membranes were there. No history of trauma or accident could be elicited.

CASE 13. Leslie H. S. DeWitt, reports: A multipara, age 38, in her fifth pregnancy. Probable confinement was estimated as January 1. The first hæmorrhage occurred August 24, with no pain. During September and October, there were two similar hæmorrhages. November 5 there was a profuse flow, with some pain similar to labor pains. She was admitted to the hospital on November 9. There was some bleeding. No placenta could be palpated. The bleeding recurred; and it was thought best to empty the uterus. Dilatation; version; child easily delivered. The placenta immediately appeared at the vulva together with many old clots. About two-thirds of the placenta was infarcted and had no attachment. The child was a premature infant of 7 months. Four hours after the operation the patient cried out that she could not get her breath; all treatment was ineffective, and she expired thirty minutes after the attack. The condition may be explained by a primary syphilis with secondary pyogenic infection.

CASE 14. Williams reports: A nullipara, age 18, 9 months pregnant; with some œdema of feet and a definite amount of albumin in the urine. Labor pains began the evening before admission, and at 6 a.m. a gush of blood occurred from the vagina. On admission a considerable amount of dark red blood was escaping from the vagina. The fetal heart sounds were not heard; the placental tissue was not felt. At cæsarean section, a dead child was extracted. Immediately following delivery, the placenta appeared in the wound, and, as it was extracted, a large amount of partially clotted blood escaped with it. As the uterus did not contract, supravaginal hysterectomy was done. A tumor developed in the right lower quadrant. The tumor mass was opened, and greenish pus escaped. The patient improved rapidly and at the end of a month was discharged.

Diagnosis. Premature separation of the normally implanted placenta, with combined concealed and external hæmorrhage. There was hæmorrhagic infarction of the uterus, right tube, and ovary; also extensive thrombosis; and peculiar degenerative arterial changes.

Three recent cases from the Evanston Hospital are typical of this type of hæmorrhage.

CASE 15. Primipara, age 36, at term, April 13, 1923. The pregnancy to date was normal. General physical examination was negative. On March 5 1923, while sitting in her living room reading, she had sudden acute pain in the lower abdomen. This was followed immediately by profuse vaginal hæmorrhage, so profuse that her trip to the bath room could be easily followed. The patient was seen by the doctor 20 minutes after the hæmorrhage occurred. The following symptoms were noted: pallor, rapid pulse, and restlessness. The patient seemed very much worried. Bleeding continued in mild degree, resembling that of menstruation, and the patient was taken to the hospital. There was no pain following the original attack until after the patient arrived at the hospital. The pains then occurred every 2 minutes. Following a hypodermic of 1/6 grain of morphine the pains and bleeding ceased. On March 7, the pains again started and there was a slow advancing dilatation of the cervix. The fetal heart was heard until 6 p.m. on March 7, but was not audible 2 hours later at 8 p.m. The first stage of labor ended at 9.40 p.m., March 7. The second stage was 53 minutes in duration, at the end of which period the head had advanced to mid-plane. An anæsthetic was given and a dead child extracted with forceps. In the third stage there was nothing abnormal.

Diagnosis. Abruptio placentæ with birth of dead fetus.

Pathology. The specimen is a placenta 20 by 16 by 2.5 centimeters with fetal membranes apparently complete and 51 centimeters of umbilical cord attached near one border. On the maternal surface are two huge blood clots 6 by 4.5 by 2.5 centimeters and 5.5 by 3.5 centimeters attached to the placental substance and here also there is a red infarct 3 by 2.5 by 1.5 centimeter. A blood vessel here is thrombosed. Near one margin of the area is a yellow white "infarct" 2 centimeters in diameter. Otherwise the placental substance is unchanged. The placenta, membranes, and umbilical cord together weigh 404 grams.

Diagnosis. Hæmorrhage into the placental substance; red "infarct" of the placenta; white "infarct" of the placenta.

CASE 16. A primipara, age 23, with normal pregnancy, came into Evanston Hospital at term. Soon after arrival she had an active vaginal hæmorrhage. Vaginal examination showed one finger's dilatation and floating head. There were no uterine contractions. A classical cæsarean section was performed, and a living baby delivered.

Diagnosis. Premature separation of placenta with external hæmorrhage. Placenta showed no gross lesion.

Pathology. The specimen is a placenta 20 by 20 by 2.2 centimeters with most of the fetal membranes missing and 55.5 centimeters of umbilical cord attached. The placental substance is grossly unchanged. The placenta, fetal membranes, and umbilical cord together weigh 615 grams.

CASE 17. A multipara, age 34, had had a normal pregnancy until June 10, 3 days before the time set for delivery. The patient was awakened early in the morning by severe vaginal hæmorrhage, followed in

one hour by the first mild labor pain. Pains recurred every 20 minutes and the patient entered the Evanston Hospital 2 hours after the hæmorrhage. After her preparation for labor the pains became more frequent, every 3 to 5 minutes. There was no bloody discharge. During the next two hours the pains lessened in frequency and severity. At the end of this period there was three fingers' dilatation and about 75 per cent effacement. Three minims of pituitrin was given, and 15 minutes later the patient had profuse uterine bleeding. The patient was prepared and vaginal examination made. No placenta could be felt. The head was in the mid-plane, and was delivered with low forceps. A live baby was delivered and the mother had an uneventful recovery.

Diagnosis. A fresh retroplacental clot was found at the margin of the placenta diagnostic of a partial premature separation of the placenta.

Pathology. The specimen is a placenta 20.5 by 17 by 2.3 centimeters with fetal membranes complete and 46 centimeters of umbilical cord attached. Attached to one border of the placenta there is a piece of freshly clotted blood 14.5 by 4 by 1.5 centimeters. The maternal surface is smooth. The placental substance is grossly normal. The placenta, fetal membranes, and umbilical cords together weigh 688 grams.

The *placenta* may be partially separated or wholly separated. In the majority of cases we find the placenta entirely separated. For example in 48 cases reported by Willson, the separation was complete in 36 cases and partial in 12 cases. In a few instances the placenta has been expelled from the uterus before the fetus. This very rarely occurs. W. D. McFarland of Glasgow, in 1911, reported the following three cases.

CASE 18. Para-VIII, aged 38, had formerly been under care for metro-endometritis. The pregnancy was normal. During the thirty-sixth week, she was seized with sudden pain, intermittently; then a sudden discharge of water followed, and she felt something protruding from the vagina. The placenta was found lying on the bed. There had been no bleeding. The head was filling a half dilated cervix. As the child was dead, the patient was left to deliver herself, which was accomplished 2½ hours after the birth of the placenta. The longest measurement of the placenta was 11¾ inches, and at no part was its thickness half an inch. Around the margin of the placenta, on its maternal surface, were white infarcts, varying from the size of a split pea to that of a horse-bean; this condition extended around the margin of the placenta for about three-fourths of its circumference.

CASE 19. A para-V, age 34, in the twenty-eighth week of pregnancy, had labor pains proceeding a little over an hour when the membranes ruptured. The placenta was found presenting at the vulva. The cord was not pulsating, so the case was left to nature. The child born in three and one-half hours had evidently been dead for some days. There was no bleeding, and none accompanied the separation of the placenta. The formation of the placenta was normal in outline; and the size and thickness were also normal. There were numerous large and small red infarcts along the margin of the maternal surface and also in the substance.

CASE 20. A multipara, aged 28, had had normal pregnancy until thirty-second week, when labor began. The membranes ruptured early. The placenta was found lying on the bed clothes. The child, dead, was delivered 3 hours after birth of the placenta. Along the periphery of the maternal and fetal surfaces of the placenta were numerous white infarctions, and three comparatively recent encapsulated hæmorrhages in the substance of the placenta situated close to the margin on the maternal surface. No hæmorrhage occurred either before or after the birth of the placenta.

PATHOLOGICAL PICTURE

The pathological picture of the placenta and the uterus in an average case of this type given by Willson in his summary of the cases which he reported January 1921, is as follows:

Macroscopical appearance of the uterus. At autopsy or laparotomy the uterus presents a very striking picture, its appearance being compared by many to that of an ovarian cyst with a twisted pedicle. The whole organ may be almost black or mottled throughout from the presence of the effused blood in its walls or under the peritoneum; or one lateral half or the anterior or posterior surface may appear normal and the opposite portion show the characteristic discoloration.

The myometrium. As might be expected, the extent o' the hæmorrhagic infiltration of the uterine musculature varies greatly. Subperitoneal ecchymosis due to e travasation of blood under the peritoneum seems to be present in all cases, and in a few it is the only lesion noted. Between such cases as these and those in which the whole uterine wall is literally inundated with blood, all stages in the process are encountered. The hæmorrhage constantly tends toward separating and tearing apart the muscle bundles, but it is only in the areas where it is most intense that the individual fibers are separated from each other. This rarely occurs. In such localities the muscle bundles may be seen occasionally as strands of tissue traversing great lakes of effused

blood. Œdema is very frequently noted, and areas free from hæmorrhage often show much œdematous infiltration. Increase in the amount of connective tissue is noted occasionally. Round cell infiltration around some of the hæmorrhagic foci has been noted, and also the presence of leucocytes containing blood pigment. Such areas probably indicate that successive effusions of blood occur, some older and some more recent.

The distribution of the hæmorrhage in the uterine wall is interesting and, from an etiological point of view, most suggestive. The process is always more profuse in the region of the fundus and upper part of the body, and the lower uterine segment seems to be frequently entirely spared. In the great majority of the cases the area of the uterine wall over the site of the placenta is the most involved and the extravasation is usually greater on the anterior, posterior, or lateral aspect of the uterus, depending upon the location of the placenta. Another striking finding is the tendency of the hæmorrhagic process to reach its maximum under the peritoneum. There are a few exceptions to this, but the great majority of the observers note particularly and specifically that it is the outermost layers of the myometrium which show the densest and deepest discoloration from the bloody effusion. In this connection it should also be remembered that in the milder cases the lesion may be limited to subserous ecchymoses. Even over the area of placental attachment the layers of musculature adjacent to the decidua may show only punctiform bleeding, which increase as the peritoneum is approached until the outermost third of the thickness of the uterine wall is literally torn asunder by a massive and brutal hæmorrhage. This is illustrated most strikingly in the colored plate of Fordyce and Johnstone, showing a cross section of the uterus through the placental site at a level just below the tubal insertions.

The observations regarding the condition of the muscle fibers themselves are rather contradictory. In 14 cases in which this point is mentioned they are stated to have been normal or healthy in 7 cases and abnormal in 7 cases. The most detailed study of the muscle fibers was made by Ley. He found marked degeneration present in three uteri studied. The degeneration seemed to be more marked in regions where the hæmorrhage was greatest, was not secondary to the hæmorrhage but was due to the same cause, namely the action of a toxin. The process was severe enough in some cases to reduce the muscle bundles to a "vaccinated matrix in which lie a very few tortuous, narrow, hyper- and hypo-chromatic nuclei." The individual fibers in such areas could not be recognized.

The decidua. The changes in the decidua are always more grave in the decidua basalis than in the parietal decidua. Hæmorrhage is the most marked lesion and is extensive enough in a few cases to cause complete disorganization. Degeneration and necrosis of the decidual cells has been noted. The decidual vessels show congestion. In the case of Young (the specimen of the case reported clinically by Kynoch) it is stated that the decidual vessels were dilated into enormous thin-walled sinuses. Ley mentions a partial closing of the decidual vessels by proliferation of the intima in one case, and some perivascular infiltration in another. Inflammatory lesions were not noted in any case and their absence was noted specifically in a few cases.

The blood vessels. Congestion, particularly of the veins, is quite uniformly present. Thrombosis of the veins in the uterine wall particularly in the neighborhood of the placental site, is noted in several cases. Couvelaire and Williams noted solutions in the continuity of the walls of some veins communicating with the areas of effusion. Williams and Morse noted changes of an endarteritic nature in the walls of the smaller arteries, but the latter states that these did not differ from those usually encountered in the uteri of multiparous patients. Maxini noted thrombosis in some vessels and a homogeneous appearance in the walls of others. Young states that: ". . . . a massive, extensive, and fairly old standing thrombosis was found in the ovarian vessels on each side, especially the left. The uterine vessels seem to be healthy." Perivascular infiltration was noted by Ley, who also states that the changes in the vessel walls did not seem to differ from those noted in the surrounding tissues. Berggren, v. Weiss, Frai-

pont, Couvelaire, Essen-Moller and Alhstrom, all note the vessel walls as being normal.

The peritoneum. The presence of subperitoneal hæmorrhagic effusion in all cases has already been noted. The most striking lesion in the peritoneum, however, and one of great importance from both a clinical and pathological point of view, is the presence in many cases of fissures or ruptures in the peritoneum, extending occasionally to the depth of a few millimeters into the subjacent muscularis. These are noted in 11 cases (Essen-Moller, Fraipont, King, Knauer, LeLorier, Ley, McNair, Shaw, Smith Smyly, and Zweifel). This represents an incidence of approximately 15 per cent. They may be single or multiple. Their direction is usually transverse, but they may also be directed in the long axis of the uterus, or have an irregular arrangement. Their position is usually on the anterior or posterior wall in the region of the fundus. It is very probable that they occur, in most instances, directly over the placental site, and such a location is definitely shown in 3 cases. I have not included in this series several cases in the literature in which the peritoneal fissures have been noted in association with accidental hæmorrhage but in which nothing is said regarding hæmorrhage into the uterine wall. There would seem to be little doubt, however, that these belong to the type of condition under discussion. Such cases are reported by White, Shannon Macirone, and Werner. The case of White is particularly interesting because it is, in all probability, the first case of uteroplacental apoplexy in the literature. The patient, a 32-year-old para-IX, died about an hour after the delivery of a stillborn fetus. Nothing is said about external or concealed hæmorrhage but autopsy showed the characteristic peritoneal lacerations, hæmorrhagic extravasations into the broad ligaments, and intra-abdominal bleeding. This case was reported in 1834.

Intraperitoneal effusion. In 31 cases in which this point is mentioned the presence of an intraperitoneal effusion is noted in 22 cases, an incidence of 71 per cent. The character of the effusion varied from a clear serum to pure blood. The amount varied from a slightly increased quantity of peritoneal fluid to an intra-abdominal hæmorrhage quite comparable to that caused by a ruptured ectopic pregnancy. In the majority of the cases the source of the bleeding is evidently the superficial lacerations described above. In one case it came from ruptured vessels in the broad ligament, in another it is believed to have come from the wall of the tubes, and in still another it was at least contributed to by complete rupture of the uterus. The cases with bloody serum frequently showed no peritoneal tears, the opposite being true when free blood was present.

The adnexa. Not the least interesting feature of the pathology is the participation of the tubes, ovaries, and uterine ligaments in the hæmorrhagic process. The broad ligaments were involved in 26 cases, the tubes in 11 cases, the ovaries in 4 cases, and the round ligaments, once. These were, of course, associated in various combinations. The lesion in the ovary was usually simply the presence of punctiform hæmorrhage. In one of Williams' cases this was extensive enough, however, entirely to isolate some graafian follicles in a bloody effusion. Punctiform hæmorrhage in the tubal wall was the usual lesion, but was occasionally extensive enough quite to disorganize it. The process in the broad ligaments varies greatly in its extent from the presence of ecchymotic spots to collections of blood which justify the term hæmatoma. The hæmorrhagic effusion may even extend beyond the broad ligaments. In one case it extended onto the bladder, and posteriorly retroperitoneally as far as the cæcum on the right and the mesosigmoid on the left; in another case it extended up behind the cæcum; and in a third up behind the sigmoid. The lesions in the broad ligaments, tubes, and ovaries are frequently unilateral, one side being free and the other involved; or the process is much worse on one side than on the other. Where this obtains there is distinct evidence to show that the severity of the condition is governed mainly by the location of the placental site, being worse on the side toward which the placenta tends to have its greatest area of attachment.

The placenta. With the exception of infarcts and the compressed zone corresponding

to the area of the retroplacental hæmatoma, the few recorded examinations of the placenta have shown an absence of pathology. Slight thickening of the stroma of the villi was noted in a few cases.

Lesions in other organs. There are more or less complete autopsy notes in 17 cases. The lesions in the liver are hæmorrhage, usually subcapsular, and acute parenchymatous degeneration Hæmorrhage without necrosis was present in 2 cases. Degeneration was noted 7 times and was central in 2 cases and peripheral in one. Hepatic cirrhosis was noted once. In one case it is stated that no normal liver tissue was left. The liver is stated to have been normal on macroscopical examination once The usual lesion in the kidney was acute parenchymatous degeneration; this is noted 7 times. Chronic nephritis is noted twice. The kidneys are reported as normal on gross examination once, and on microscopical examination once. Hæmorrhage in the diaphragm was present twice, in the pericardium once, in the meninges once, in the mucosa of the stomach twice, and in the adrenals once. One patient had apical tuberculosis.

The fetus. There are 2 autopsies on the fetus reported, one by Couvelaire, and one by Oldfield and Hann. In each instance extensive hæmorrhages into various viscera were noted. Are these lesions the result of the asphyxia caused by placental separation, or are they a manifestation of the similar lesions in the mother? As yet this question can not be answered. It is interesting to speculate, however, in view of recent claims that cerebral hæmorrhage in the newborn is often not of traumatic origin, but due to dyscrasias of the fetal blood, whether a possible antenatal poisoning of the fetus may not exist in some cases, which will enable us to trace an etiological relationship between cerebral hæmorrhage in the newborn and maternal toxæmia.

DIAGNOSIS

Holmes, in his report, stated that this condition was diagnosed, by clinical symptoms, only once out of every 500 cases. There is no doubt but what the same condition occurs in mild forms in many of our cases. Little is thought of a patient during the early stages of her labor, complaining of constant severe pain in the abdomen accompanied with some vomiting and bloody discharge, but no doubt if the entire case was more carefully observed and the placenta carefully examined, we would be able to report more cases of premature separation of the normally implanted placenta. I have in mind a few cases in which the differential diagnosis between placenta prævia and premature separation of the placenta was very difficult and, although such a condition as a combination of the two is impossible, according to a recent authority, I wish to report the following cases as illustrations.

CASE 21. G. J. McIntosh reports the case of a multipara; age 27; 3 normal labors; always in good health. She expected to be confined about April 30. In February she lifted a heavy object weighing about 175 pounds. That evening she felt considerable pain in left lower quadrant of abdomen. All during February the pain continued. February 24 she was found in condition of shock. Abdomen was distended and tense, and no blood had escaped externally. "While I was washing up to examine her, there was a great gush of thin, very dark-colored fluid. So great was the amount that I concluded that the sac had ruptured; but such was not the case. The cervix was soft and admitted two fingers." The edge of the placenta could be felt near the presenting head. She was moved immediately to the hospital. Manual dilatation; forceps. After extraction of the baby a very large amount of dark clot was removed. There was no more hæmorrhage; the patient was apparently bled dry. She lived about an hour after the baby was delivered.

CASE 22. A multipara, age 35, had had 6 normal labors, and had now been pregnant about seven months. She had fallen down a stair; and her condition was similar to that in Case 21. When making digital examination, thin, dark blood gushed away in large amount. She expired suddenly while preparations were being made to extract the child.

In both cases a physician was not summoned until intra-uterine hæmorrhage had attained fatal proportions.

CASE 23. Reported by M. Garipuy. The patient was attended by a midwife; parity, not given; age 23; 8½ months pregnant. Much albumin in the urine persisted to the moment of labor. The pregnancy was normal with the exception of the presence of albumin. There was sudden, very abundant hæmorrhage eight hours after the beginning of labor pains with cessation of movement of fetus and other

grave symptoms. The midwife attempted to check the hæmorrhage with cold vaginal injections; in the meantime the bag of water ruptured; and the hæmorrhage persisted. The midwife attempted to revive the fainting patient with ether and subcutaneous injections of caffeine. The author arrived at the moment the patient was regaining consciousness. Diagnosis: separation of placenta, perhaps prævia.

The head of the child was engaged; the cervix, was dilated only 3 centimeters the membranes were ruptured. Bimanual dilatation failed. Lateral incisions à la Duehrssen, with application of forceps delivered a dead fetus of a size corresponding to length of pregnancy. The placenta delivered. On the fetal side of the placenta there was a large new clot covering about two-thirds of the surface. Distance of border of placenta from opening of membranes, 15 centimeters.

The hæmorrhage ceased on termination of labor. Albumin diappeared entirely.

CASE 24. Reported by Burnley Lankford. A para-III, nine days after the date of predicted labor, in the morning while at her housework, had a sudden gush of blood, but no pains. The least change of position caused blood to gush. She was removed to the hospital. Examination showed membranes intact, pouched down much further than normal; the placenta could not be felt. Blood flowed freely during examination. Dilatation; membranes ruptured. The cervix was beginning to tighten a bit at intervals, showing labor pains were probably starting; a tight perineal pad was applied, together with tight abdominal binder, and the patient was returned to ward to await developments. The patient delivered herself rather precipitately of a lusty male child, late in the afternoon. A few clots came directly after delivery, and the placenta, being found in the vagina in about five minutes, was easily expressed, followed by more clots. The placenta showed a white, tough infarct about 1 inch in diameter, near the margin. There was a hole in the center of this infarcted area probably ¼ inch in diameter, leading down to the membrane.

CASE 25. J. P. Hartman reports the case of a para-III, age 25, with a history of diphtheria, complicated with nephritis at 9 years. There was œdema during the first pregnancy, and albumin in the urine during the second pregnancy. In the sixth month of the third pregnancy there were symptoms of old nephritis, and during the last three months, œdema; and albumin in the urine. On examination, the placenta was felt and placenta prævia suspected. A rubber balloon was introduced. After seven hours amniotic fluid escaped with blood clots. Pressure on the uterus expressed the placenta, followed by a six month's fetus. The mother did not respond to stimulants and died at midnight. The placenta had the characteristic appearance of premature separation. There were infarcts over an extensive area and large blood clots; one was as large as a walnut on the maternal surface of the placenta. There were old, firmly compacted blood coagulations.

Autopsy: Chronic nephritis; left kidney hypertrophied; transudation fluid in pericardium and peritoneum; all organs picture of anæmia. Placental attachment high at the back of fundus.

CASE 26. Holmes reports a border line case between placenta prævia lateralis and ablatio placentæ in a para-III, age 32. During this pregnancy she suffered from constipation, had poor appetite, and toward the end swollen legs. During the first three months there was an almost constant discharge of blood; thereafter at intervals of three to four weeks she would have pains as if labor were commencing, with gushes of white fluid. The labor pains were strong; there was slight hæmorrhage. The next morning the membranes ruptured; hystereurysis, then craniotomy; Credé. The placenta offered nothing characteristic of ablatio placentæ. The opening in the membranes was about seven centimeters from the placenta in the sortest distance. Placenta showed no gross manifestations to explain the hæmorrhage, beyond some darkening of the lower half of the maternal surface. Chorion offered no clue as to the precedent hydrorrhœa gravidarum.

One important point in the differential diagnosis of placenta prævia and premature separation of normally implan ed placenta is a careful examination to ascertain whether or not the placenta can be felt. In two of the cases just reported, the placenta was felt, which would signify a placenta prævia, but following surgical or obstetrical investigation the placenta was found to be entirely free. Personally, I am unable to conceive of a condition of this kind being a simple placenta prævia. Unfortunately, the placentæ in these cases were not examined for areas of infarction or for areas covered by organized clots. Such cases as these are most interesting to me, and I will gladly accept any explanations as to what to place as the cause of the separation of the placentæ, if these cases are to be called simple cases of placenta prævia.

TREATMENT

The treatment of this condition depends upon the amount of hæmorrhage, external or concealed; on the amount of toxæmia and upon the amount of dilatation. In those cases, especially in primiparæ, in which the cervix is tight and the symptoms of concealed hæmorrhage such as shock, pallor, thirst, rapid pulse, and pain are present, the only treatment is surgical, the classic cæsarean section being preferred, the vaginal section

contra-indicated, principally, because of the field being flooded by hæmorrhage. The following case will be sufficient to illustrate the above statement.

CASE 27. W. Fordyce and R. W. Johnstone report the case of a primigravida whose confinement was expected July 16. June 17, the physician was called because of a "breathless attack"; some œdema of the legs; and constant pain in abdomen. There was slight external hæmorrhage; no fetal heart sounds were heard. Vaginal examination was negative. She was removed to the hospital. Urine was scanty, and contained a large quantity of albumin. Diagnosis of concealed accidental hæmorhage with progressive toxæmia was made. Cæsarean section was done. The upper part of the anterior wall of the uterus was congested and hæmorrhagic. The placenta lay on the posterior and right lateral walls. It was separated from the right lateral wall by a large retroplacental clot, while its left half was still attached to the posterior uterine wall. A dead child was immediately extracted. The placenta was detached manually. Supravaginal hysterectomy was done because of the condition of the uterus. The patient died 4 hours later in an eclamptic seizure.

Fordyce and Johnstone say that the view generally accepted by most writers is that both the retroplacental hæmorrhage and the eclampsia or eclamptism are manifestations of one common underlying toxæmia of pregnancy. Because of different views held, however, he is doubtful if any definite conclusion can be reached. He thinks all such cases should be recorded for study.

It is becoming more and more the tendency to treat these cases, which are not too severe, obstetrically. During the last 3 years, we have had three cases in the Evanston Hospital which have been treated in this way. The report of these is as follows:

CASE 28. A para-V, age 42, gave a history of œdema and albuminuria during the first pregnancy; the other four were normal. At term, January 10; on December 28, the membrane ruptured at 8 a.m.; she arrived at the hospital at 9:30; there was four fingers dilatation with pains every three minutes. There were no fetal movements and the heart was inaudible. Delivery was spontaneous at 10 a.m. The placenta was completely delivered in 20 minutes. There was a large area of infarct in the middle of the placenta, one-third of the whole area was involved. Diagnosis: Recent apoplectiform placenta.

CASE 29. A primipara, age 27, at term, January 30, began labor at 2 a.m. on January 21. She was taken to the Hospital at 2:30 a.m.; and was seen by the attending physician at 4:30 a.m. The uterus was distended and tense with fluid wave present. No heart tones were heard. Position was indistinct; one finger dilatation. The progress was slow; morphine was administered twice; dilatation was complete at midnight; then the outline of parietal bones were felt. The meconium was coming away.

Second stage: The head descended to the perineum; and a low forceps delivery was done. Many clots followed child out of uterus; the placenta was expelled in ten minutes. The placenta was 80 per cent detached. Diagnosis: Premature detaching of placenta. Fetus showed beginning maceration.

CASE 30. Para-III, age 29, went to labor 5 p.m. May 6, and was seen by the attending physician in the hospital at 6 p.m.

First stage: Two and one-half finger dilatation; head movable; membrane unruptured; no heart tones; no placental sounds; pains every four minutes; labor normal with rapid dilatation.

Second stage: Short easy delivery, spontaneous; small dead unmacerated child; large amount of old clots following child.

Third stage: Placenta expelled in 10 minutes; many old clots; deeply infarcted placental area of recent hæmorrhage. Diagnosis: Premature detachment of placenta with intra-uterine bleeding.

In these last three cases the delivery was spontaneous.

The following three cases illustrate more active obstetrical interference.

CASE 31. Reported by F. L. Adair: A multipara, age 30, who had had no miscarriages, one premature birth at 7 months, eight full term pregnancies, all uneventful, was now at term. For a couple of weeks she had noticed some blood. When labor pains began there was more bloody discharge, with constant pain in abdomen and back, general condition poor, pallor, abdomen distended and tender. Fetal parts could not be palpated; and no heart tones heard. No placenta was felt; there was considerable bloody vaginal discharge. Manual dilatation; version; stillborn male child delivered. Placenta came away at the same time, followed by some dark blood clots. There was very little fresh bleeding. One hour later the patient became suddenly worse, and developed symptoms of pulmonary œdema. The respiration ceased, though the heart kept on beating for about half an hour.

CASE 32. A multipara, 38 years old, 8 months pregnant, four hours previous to entrance felt severe pain in right side. Examination at the hospital revealed pulse 136; clothes soaked with blood. Version; dead child delivered. The placenta was born before the cord could be clamped. The placenta was small, and one-half was infarcted, the other half covered with fresh and old blood clot. The patient was discharged on the tenth day. The urine still showed a slight trace of albumin with an occasional hyaline cast.

CASE 33. Virginius Harrison reports the case of a primipara, age 37, with last menses September 15,

who was taken sick April 1 with intermittent cramps and external bleeding. April 4 there were severe pains with very little bleeding. April 5 she entered the hospital, with some bleeding and regular labor pains. The fetus could not be outlined. Manual dilatation; rupture of bag of waters; breech presentation. With little traction on a foot, the uterus soon expelled a macerated fetus of about 5 months. The placenta was removed manually, with no difficulties, as it was completely detached. About half a pint of old dark clots were removed from the uterus. The placenta was covered, with the exception of a space of the size of a half dollar, with an old clot about a half inch thick and very black. The placenta was made up of numerous infarcts of varying degrees of thickness and color, indicating that the woman had had numerous hæmorrhages into her placenta until the fetus got so little nourishment that it did not grow to its full size. It also showed that thrombosis had taken place to such an extent that nature was enabled to stop the bleeding from the remaining sinus. Patient a little anæmic but on a fair road to recovery. Urinalysis showed a slight nephritis.

CONCLUSIONS

1. Mild cases of premature separation of the normally implanted placenta are more frequent than is commonly believed.

2. Etiologically, this type of hæmorrhage can be classified as toxic and traumatic, the latter being much in the minority.

3. Mild toxæmias are capable of producing small areas of infarction with resultant mild hæmorrhages, with little discomfort to the mother, but fatal to the baby.

4. Approximately the same toxæmias of pregnancy resulting in eclampsia are responsible for a premature separation of the placenta.

5. Expectant treatment should be resorted to in all mild cases of premature separation of the placenta. In extreme concealed hæmorrhages, the treatment should be surgical, preferably cæsarean section.

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THE ETIOLOGY AND TREATMENT OF NON-TUBERCULOUS PULMONARY ABSCESS[1]

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THE etiology of non-tuberculous pulmonary abscess is important for the reason that a very large percentage of these cases could be avoided by more careful technique in performing operations upon the upper respiratory tract under general anæsthesia. The etiology in the last 100 cases of my own could be definitely established in all but 8 and is as follows: In 66 cases there had been an operation on the upper respiratory tract under general anæsthesia, directly preceding the lung infection. (In 48 cases tonsils were removed, in 12 teeth extracted, in 2 septic sinuses drained, in 1 adenoids removed, in 1 a deviated septum straightened, in 1 a broken nose operated upon, and in 1 a tracheotomy was done.) Pneumonia was the cause of the abscess in 22 cases (bronchopneumonia occurring 20 times and lobar pneumonia twice). Septic infarct was the etiological factor in three instances and a bronchial œsophageal fistula in one.

Other causes not included in this series are operations for malignant growths of the jaw and tongue, extension of infection into the lung from a focus outside of it (as, for example, subdiaphragmatic abscess, mediastinal abscess, rupture of an empyema into the lung), actinomycosis, foreign bodies, including not only those that are aspirated into a bronchus, but projectiles lodging in the lung (the former in my opinion are more apt to produce a localized bronchiectasis with bronchiectatic abscess or abscesses than a simple pulmonary abscess), and the aspiration of infected water while swimming.

These figures of my own—66 cases out of 100, in which the lung infection was directly preceded by an operation on the upper respiratory tract, performed under general anæsthesia—are startling. It does not lie in the province of this paper to discuss how the infection of the lung takes place, there being several theories, except to say that the most common sense one, at least to my mind, is that it is due to the aspiration of infected material during the operation. It seems only fair to state that the percentage of cases which develop pulmonary abscesses following these operations on the upper respiratory tract must be exceedingly small when the thousands of tonsillectomies and extractions of teeth that are done every day are considered. Although pulmonary abscess occasionally follows an operation performed under local anæsthesia, yet there is none in this series. It is only just to the nose and throat specialists to add that, in this series, only one case had been operated upon by an expert.

TREATMENT

Treatment may be divided into expectant (or medical), artificial pneumothorax, bronchoscopy, and operation.

In *expectant treatment* the patient is kept quiet in bed, given good nourishing food, fresh air and sunshine, and an attempt is made to keep the cavity emptied by postural drainage. Two or three times each day the patient should be placed in a position (usually with head over the side of the bed) which will cause the abscess to drain into a bronchus and then its contents may be coughed up. For this treatment to be successful intelligent cooperation on the patient's part is necessary. In 86 cases of my own 11 recovered with this treatment (10 per cent). In Lord's (5) 100 cases 7 spontaneously recovered (7 per cent). Lockwood (4) reported 16 recoveries out of 27 cases (51 per cent). This is the largest percentage of recoveries that I have seen reported. Wessler (10) states that in 33 per cent of all cases of acute pulmonary suppuration following tonsillectomy the patients recover spontaneously within 2 months. Statistics collected by Lenhartz (3) from three municipal hospitals in Berlin, 1905, showed that there was a mortality of from 60 to 100 per cent following expectant treatment. There is always danger of brain abscess, meningitis,

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septicæmia, extension of the process in the lung and fatal hæmorrhage. This risk must be taken into consideration when expectant treatment is advised. In practically all cases it is justifiable to give the patient a trial with this treatment, under close observation, before operation is undertaken. As long as there is a steady gradual improvement, the expectant treatment may be continued, but, if at any time this ceases, or the condition of the patient becomes worse, surgery should be strongly considered.

Artificial pneumothorax. This may be used in conjunction with postural drainage in early cases in which the lung and costal pleura are not firmly adherent. In the cases in which there are strong adhesions I have never seen any evidence pointing toward a permanent cure. In certain cases, following artificial pneumothorax, the foul odor of the sputum and breath lessens very much, or indeed disappears, and the paroxysms of coughing may be temporarily relieved, but they soon return. Tewksbury (8) has reported 14 cases treated by this method in which there were 11 cures and 2 deaths. On the other hand, the literature for the last 19 years shows an absence of any considerable number of successfully treated cases. How long this treatment must be continued in the favorable cases (those that are early and not adherent) must depend on each individual case, but it seems probable that it must extend over a period varying from 3 months to a year, or possibly longer. The danger of air embolus should be remembered, and, also, when there are adhesions present the artificial pneumothorax may, in tearing or stretching these, open an abscess that is situated in the periphery of the lung and cause an empyema. (I have had one such experience.) Artificial pneumothorax may be of benefit in determining whether or not adhesions are present. I cannot believe that any large number of cases will be cured by this method, but feel that a small percentage may.

Bronchoscopy. Aspiration of the abscess by means of the bronchoscope, in the specialists's hands, with the dilatation of bronchial strictures, if present, may improve the condition. Indeed, several cases of permanent cure have been reported. (It is my belief that foreign bodies lodging in a bronchus produce a bronchiectasis, or bronchiectatic abscess, rather than a simple pulmonary abscess, and in these the removal of the foreign body frequently cures the suppurative condition.) If this treatment is begun at an early stage of the disease it is reasonable to expect better results from it than if it is not begun until the condition has existed for months. Willy Meyer (6) reports two cases cured by Lynah. One followed aspiration of the stomach contents during an abdominal operation and the other had been preceded by a tonsillectomy. The first case was cured after 6 months of bronchoscopic aspirations done at regular intervals. The second case was cured after one such treatment. In both instances this treatment was instituted early. Meyer also reports four similar cases treated by Richard Jordan (3 in conjunction with Lynah) in which permanent recoveries were obtained. In the long standing cases some improvement may take place with this treatment, but it seems very doubtful if any permanent cure would result. It may be that this treatment combined with surgical drainage would be of value, especially in those cases which do not progress satisfactorily following operation.

Operation. All cases in which the lung and costal pleura are adherent can and should be operated upon under local anæsthesia, provided the approach to the abscess has been correctly chosen. When the operation is performed under local anæsthesia if at any time the patient coughs and raises pus, it can easily be gotten rid of, whereas, if he is under general anæsthesia, any pus that reaches the main bronchus may be aspirated into the lung on the opposite side. If a section of one rib only is to be removed, local blocking of the intercostal nerves above and below the rib, after the skin has been anæsthetized, is all that is necessary. When a section of several ribs is to be removed, paravertebral anæsthesia should be used. In this the intercostal nerves are blocked close to the vertebral column. This anæsthesia is perfect when the approach is from the back or posterior axillary line. If the site of operation is more anterior, local anæsthesia may be used to supplement this.

When the lung and costal pleura are not adherent and the normal pleural cavity (one without any adhesions in it) must be opened in order to localize the abscess, some form of differential pressure anæsthesia should be used. There are four possible methods: First, the negative pressure chamber (Sauerbruck's chamber); second, intratracheal insufflation (method of Meltzer and Auer); third, pharyngeal insufflation; fourth, the mask apparatus—the mask of a gas oxygen machine, when fastened snugly to the face, works satisfactorily. The pressure obtained from the gas oxygen machine is sufficient to keep the lung well expanded. I prefer this method as it is the simplest.

There are many reasons why it is safer for the patient, when exploring a pleural cavity in which there are no adhesions, to use some form of positive pressure anæsthesia. When a normal pleural cavity is opened wide (that is, the opening is large enough to permit the surgeon thoroughly to explore it), if no form of differential pressure anæsthesia is used, the lung collapsing may reduce the respiratory area too quickly, and also there may be a fluttering of the mediastinum. In this, the contents of the mediastinum flap back and forth without support, and this causes a deleterious effect on the heart, great vessels, and nerves, and may even produce asphyxia. When it is necessary to suture the lung to the chest wall, if it is in a collapsed state it is difficult to place sutures and bring the lung to the chest wall without tearing it, whereas, if it is held satisfactorily in full expansion, by differential pressure anæsthesia, this is a very simple procedure.

No definite rules can be formulated as to operation. If there is very little sputum, one or two ounces in 24 hours, and the sputum is not foul, if there is no evidence of sepsis, immediate operation is not advisable. On the other hand, if the sputum is very foul, large in amount, and marked sepsis is present, operation should be performed. Abscesses which are situated in the periphery of the lung and in which the X-ray demonstrates a fluid level, are more favorable for operation than those situated deeply about the root of the lung. If there is no improvement in 4 to 5 weeks, or if, at any time, the patient's condition becomes worse, operation should be strongly considered. In delaying operation too long it should be remembered there is always the danger of brain abscess, meningitis, septicæmia, extension of the process in the lung and fatal hæmorrhage. The more chronic a case becomes, the more difficult it is to cure, as the abscess wall becomes thicker and firmer through fibrous tissue formation.

It is necessary to locate the abscess at the first operation. We know that in most cases the lung and costal pleural will be adherent and that this will take place in the region nearest to the abscess. Therefore, it is this region that the surgeon should try to find and having found it should drain the abscess through it. If the lung and costal pleura are not adherent they should be made so before opening the abscess. The correct approach to the abscess having been determined as accurately as possible by means of X-ray and physical examination, under local anæsthesia, a window in the chest wall is opened down to the pleura. Sections of one or two ribs should be removed, and the pleura should be carefully inspected. If the lung and pleura are adherent and this exposed region is near the abscess, the pleura will look and feel thickened. It will have a grayish-white color, feel firm rather than soft as a normal pleura feels, and the lung will not be seen moving with respiration. If this condition is found the lung may be immediately opened and the abscess cavity found and drained. On the other hand, if the lung and pleura are not adherent, the lung will be seen moving up and down with respiration beneath the pleura and the pleura itself will appear and feel normal. Then further search should be made for the adherent area by a resection of one or more ribs. If this area is finally found the abscess should be immediately opened through it. It may be impossible to find an adherent area. Then, under positive pressure anæsthesia, the pleural cavity should be opened widely and the lung palpated for the abscess. This region may be easily differentiated from normal lung by the sense of touch. It will appear as a localized, hard, indurated area and obviously very different from the soft, spongy, normal lung. This area should then be brought up to the chest wall

and sutured there. If there are no adhesions about the other lobe of the lung, so that it would collapse without positive pressure anæsthesia, it too should be sutured to the chest wall. A gauze sponge should be placed against the abscess area and the wound closed. Three to five days later, under local anæsthesia, the wound is again opened. (If the abscess should be opened at the first operation, in spite of suturing the lung to the chest wall and packing the area with gauze, in at least 50 per cent of the cases there will be a leakage through the suture so that an empyema will result.) At this second stage the newly formed adhesions will have securely walled off the whole pleural cavity from the abscess area. This may now be considered extrapleural. The abscess at this stage should be opened and drained. An incision is made into the lung and the abscess broken into with the finger. In this way the finger will tend to push to one side any blood vessel that it may meet, whereas, if the abscess is opened with a cautery, it will cut through the blood vessel and sear it over so that there will be no immediate bleeding, but when sloughing takes place a few days later there may be a secondary hæmorrhage. The abscess should be drained with a very soft rubber tube. (Gauze wicks prevent good drainage and the patients are very uncomfortable, as the abscess must still be drained by coughing and raising until the gauze is removed.)

Acute abscesses must be drained for 4 or 5 weeks or possibly a little longer. In the chronic cases it is necessary to continue drainage for a much longer time than in the acute cases. Drainage for 3 to 4 months, 6 months, or even longer, may be necessary.

RESULTS OF SURGICAL TREATMENT

Tuffier in 1897 (9) reported 23 cases with a mortality of 26, and 74 per cent cured. Murphy (7) in 1898 reported 96 cases with a mortality of 39, and 61 per cent cured. Garre (1) in 1912 reported 182 cases with a mortality of 18.6 per cent. Hedblom (2) in 1919 reported 54 cases with a mortality of 23 per cent. Lockwood (4) in 1922 reported 27 cases with a mortality of 41 per cent. In 1915 I reported 27 cases with a mortality of 25 per cent; in 1921, 21 cases with a mortality of 16 per cent; and in 1923, 52 cases with a mortality of 15 per cent (11).

From these figures it may be assumed that the mortality will vary from 15 to 35 per cent. This may be accounted for in various ways, one of which is that the kinds of cases presented for operation will vary greatly. When the abscess is situated in the periphery of the lung, and this is adherent to the costal pleura with an easy approach, the result of operation will be better than when the abscess is situated deeply in the lung and this is not adherent to the costal pleura. Other factors, such as age, condition of the patient, etc., must enter into the ultimate result.

From 60 to 70 per cent of the cases operated upon may be expected to be cured or permanently improved. In a few of the long standing chronic cases it may be necessary to establish a permanent fistula, and it is these that are classified as permanently improved. They can lead a useful life but cannot enjoy swimming or take violent exercise. There is a small group of about 5 per cent of the cases that leave the hospital in excellent condition having made a good recovery following operation. These do well for a few months and then begin to have more cough and expectoration. Soon after this they begin to have small hæmorrhages which gradually increase in amount until the patient finally dies during a severe hæmorrhage.

CONCLUSIONS

1. It is important for the surgeon performing operations on the upper respiratory tract under general anæsthesia to bear in mind the danger of lung infection and arrange his technique so as to avoid this complication.

2. From 10 to 30 per cent of the cases may be expected to be cured by expectant treatment.

3. Artificial pneumothorax may cure a very small number of cases. It should be used only in those cases in which the lung and costal pleura are not adherent. It is an excellent means of determining whether or not adhesions are present.

4. Bronchoscopy may cure a very limited number of cases if treatment is established early.

5. Surgery offers an excellent chance for cure in those cases in which other methods of treatment have failed or are unsuitable.

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PRINCIPLES INVOLVED IN THE TREATMENT OF ACUTE AND CHRONIC EMPYEMA[1]

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A SUBJECT so extensive as the one assigned to me cannot be discussed in the limited time of twelve minutes; it can only be outlined. Mention, therefore, can be made of only the salient points.

In acute empyema the most important object of treatment is to save life. But this must not be the sole object; it is also important to prevent chronicity. Fortunately, the type of treatment which is most effective in saving life is also the one which usually reduces to a minimum the possibility of chronicity. The three most important principles in the treatment of acute empyema are: (1) the avoidance of open drainage during the stage of acute pneumonia, to be followed in nearly all cases by free drainage at a suitable time; (2) irrigation of the cavity; and (3) maintenance of the nutrition of the patient.

The experience of the United States Army in the war clearly demonstrated the effectiveness of the principle of the avoidance of an open drainage during the stage of acute pneumonia. At Camp Lee the Empyema Commission saw the mortality drop from more than 40 per cent to less than 5 per cent when this principle was carried out. Similar striking reductions were also noted elsewhere. In civil practice, since the war, equally remarkable mortality figures have been obtained when adherence has been made to this principle. At the St. Louis Children's Hospital, since September, 1919, we have treated 86 cases of acute empyema by a plan of repeated aspirations during the pneunomic stage followed by free drainage. In this series there have been ten deaths, but not a single case has been fatal which was not accompanied by serious complications, such as suppurative mastoiditis or meningitis. This mortality of 11 per cent compares very favorably with the high mortality which we formerly expected to have with children, 54 per cent for example, as reported by Holt[2] in 1913. It seems to make no practical difference in results whether a plan of repeated aspirations or one of continuous closed drainage is used during the stage of acute pneumonia. There is no particular magic in any code of details. The important matter is not to create an open pneumothorax while a pneumonia exists. In the pneumococcal type of empyema, there is less likelihood of committing this mistake because usually by the time empyema is recognized, the pneumonia has subsided. In the streptococcal type, however, the empyema is usually coincident with the pneumonia. The principle of treating empyema by aspiration or continuous closed drainage is an old one which has been repeatedly rediscovered. Hewett,[3] in 1876, and Buelau,[4] in 1891, both described excellent methods. Diedrich[5] was one of the first to introduce it into army work. A rational explanation of why an open pneumothorax should be avoided during the stage of pneumonia was first supplied by R. D. Bell and the writer,[6] while members of the Empyema Commission. Briefly, the explanation lies in the fact that when the vital capacity[7] is low a small opening in the pleura is more likely to induce a fatal asphyxia than when the vital capacity is high. In pneumonia, the vital capacity is often so low that it practically equals the tidal air requirements; in such a case an opening of any size is likely to be followed by a fatal asphyxia. These conclusions do not hold good if adhesions are present or if the mediastinum has been made rigid by

[2] Holt. Am. Med., 1913, xix, 381.

[3] Hewett, F. C. Thoracentesis; the plan of continuous aspirations. Brit. M. J., 1876, i, 317.

[4] Buelau, G. Fuer die Heber Drainage bei Behandlung des Empyems. Ztschr. f. klin. Med., 1891, xviii, 31.

[5] Diedrich, V. P. A review of the treatment of purulent pleuritis (empyema) at Camp Pike Base Hospital. Surg., Gynec. & Obst., 1919, xxviii, 362.

[6] Graham, E. A., and Bell, R. D. Open pneumothorax; its relation to the treatment of empyema. Am. J. M. Sc., 1918, clvi, 839. For a later discussion, see also, Graham, E. A. Recent phases of thoracic surgery. J. Am. M. Ass., 1923, lxxx, 1825.

[7] The term vital capacity as used in this article means the maximum amount of air that can be expired after a maximum inhalation. It can be readily measured with a spirometer. To physiologists the term carries this very definite significance.

[1] Presented before the Clinical Congress of the American College of Surgeons, Chicago, October 22–26, 1923

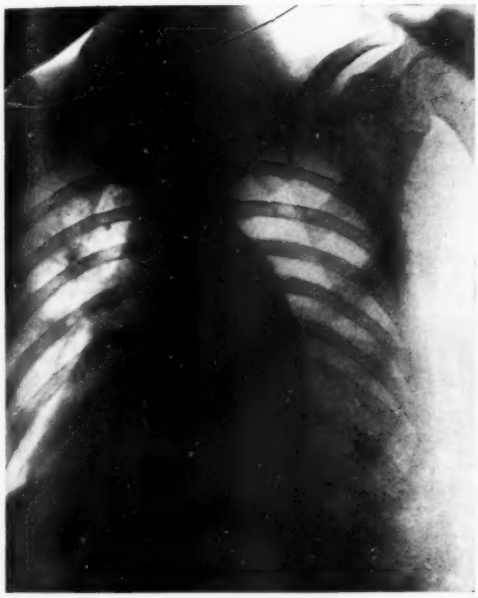

Fig. 1. Roentgenogram of a case of acute empyema seen in March, 1920.

Fig. 2. The same patient after open drainage had been instituted. The pus obtained showed a pure culture of hæmolytic streptococcus.

induration. When the open drainage is carried out after the subsidence of the pneumonia, not only has the vital capacity by that time increased to such an extent that a small pleural opening is no longer likely to induce a fatal asphyxia, but there are also usually adhesions present which minimize still more this danger.

If this plan is carried out it will be found that about 10 or 15 per cent of the cases will require no later operation for drainage. Sometimes after one or two aspirations no further exudate will be formed. If, however, the exudate persists, the most convenient criterion of when to institute open drainage is the character of the exudate. This should be definitely and moderately thick pus before creating open drainage. Certainly serous and serofibrinous exudates should not be drained openly. The object should be to create an abscess and then drain it, just as in other acute surgical inflammations. Much harm results from the drainage of serous exudates not only in pyogenic infections but also in tuberculosis. When drainage has been de-

Fig. 3. The same patient 2 days after drainage. Note how rapidly the lung has come out to meet the chest wall to obliterate the cavity. At this time the patient left the hospital without permission and removed drainage tube.

Fig. 4. The same patient 3½ years later than shown in roentgenograms, Figures 1, 2, and 3, when he returned with a large recurrence of pyopneumothorax. On readmission he stated that within 2 or 3 weeks after taking out his tube the wound healed over and he remained perfectly well for about 3 years, during which time he engaged in heavy manual labor. In spite of the absence of symptoms, it is clear that his empyema was not healed, because the cavity was not obliterated. A follow-up letter to him would have received undoubtedly a favorable answer. This clearly emphasizes the importance of having the cavity obliterated before one can be sure that a case of empyema is healed.

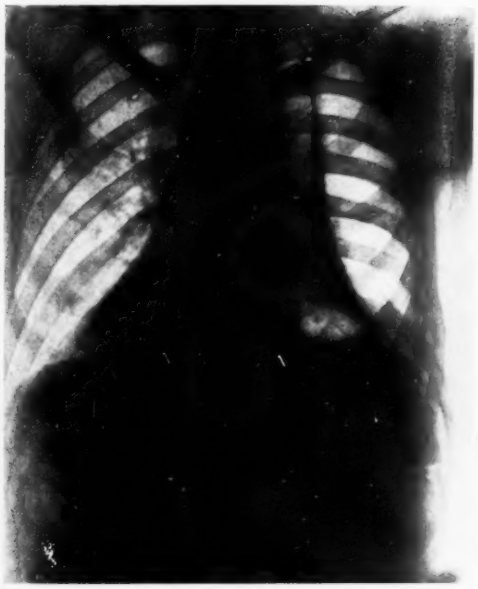

Fig. 5. The same case after drainage 3½ years after his first drainage. The cavity is now clearly much larger than it was originally and the patient is, therefore, in worse condition than at the time of the first operation. He also had a large bronchial fistula leading into the pleural cavity.

cided upon, it should be adequate and not a compromise. Our own opinion is in favor of the subperiosteal resection of a portion of rib, although there are many who prefer an initial trial of drainage through an intercostal space. The operation can usually be done satisfactorily with local anæsthesia, but with apprehensive children I believe nitrous oxide and oxygen are preferable. The site of the drainage should obviously be at the most dependent portion of the cavity. Ordinarily the removal of a segment of the eighth or ninth rib in the posterior axillary line will prove to be satisfactory. At the time of the rib resection we inject the corresponding intercostal nerve as well as the one immediately above and below with 95 per cent alcohol, a suggestion which I think was first made by Davies.[1] This procedure, by paralyzing the nerves, eliminates much of the postoperative pain. For the past two years we have also been rubbing sterile bone wax into the open cut ends of the ribs before the pleura is opened in order to minimize the creation of an osteomyelitis of the rib.

Irrigation of the cavity is effective in hastening the healing. For this purpose I do not know of any better solution than the sodium hypochlorite solution proposed by Dakin. Its value seems to lie not so much in its direct bactericidal power as in the fact that by rapidly removing masses of fibrin and necrotic tissue which coat the lung and also lie free in the pleural cavity, sterility is usually rapidly accomplished because the large number of bacteria which are embedded in this tissue are rapidly removed. Also the early removal of this thick layer of fibrin

[1] Davies, H. Morriston. Surgery of the Lung and Pleura. New York: Paul B. Hoeber. 1920.

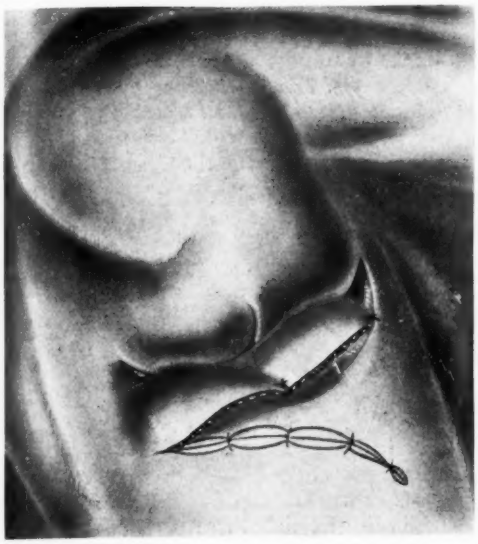

Fig. 6. One convenient method of obliterating relatively small cavities is by turning in a pedicle flap of skin and subcutaneous tissue into the cavity as shown in this drawing. The pedicle of the flap after 2 or 3 weeks is cut across.

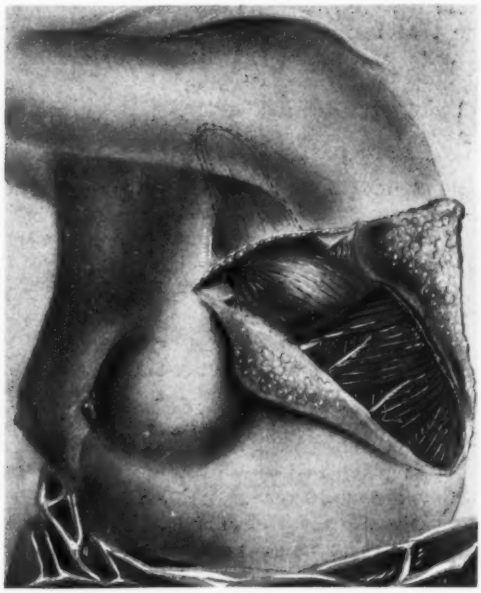

Fig. 7. For obliterating the cavities which extend into the apex a convenient method is to dissect up the latissimus dorsi muscle from its bed, leaving it attached by its tendon of insertion and turning the entire body of the muscle into the cavity.

from the visceral pleura by the Dakin's solution seems to permit a more rapid expansion of the lung than is otherwise possible. In cases in which a direct communication with the lung (a bronchial fistula) exists, caution is necessary in carrying out the irrigations, and in some cases it will be necessary to postpone the irrigations until this communication has healed. Usually the small pulmonary fistulæ will be healed in a few days if the irrigations are withheld.

The maintenance of the nutrition of the patient is of the utmost importance. Forced feeding with a high caloric diet should be the rule. Accurate knowledge of whether the patient is gaining should be obtained by weighing at regular intervals. In the average adult the gain should be from 2 to 5 pounds per week during the first few weeks after establishing drainage. Other important hygienic measures are a liberal allowance of fresh air and heliotherapy. At St. Louis we follow a scheme very similar to that suggested by Rollier[1] for tuberculosis, modified by the use of a quartz lamp in the winter time as a substitute for the sun's rays.

When is an empyema healed? The answer is: Not until the cavity is both sterilized and obliterated. Not until then can the patient be assured that he will not have a recurrence. It cannot be too strongly emphasized that the mere healing over of the drainage opening is no indication that the empyema is healed. I have known patients to consider themselves well and even to be able to engage in heavy manual labor for years after the drainage opening has healed, only to have a recurrence later. In one case (see Figs. 1 to 5) a man was engaged in heavy manual labor for 3 years after his draining opening had healed and then gave evidence of a recurrence; at the second operation he had 1000 cubic centimeters of pus in his chest. It is for this reason that I can not agree with those who advocate the closure of an empyema, regardless of the remaining cavity, even if successive cultures

[1] Rollier. Heliotherapy. Oxford Medical Publications, 1923.

from it have shown no growth. It seems to me that many of these cases will certainly develop a recurrence. Artificial aids to the spontaneous obliteration of the cavity are blowing exercises and general exercises. The progress in obliteration should be noted by measuring the capacity of the cavity at regular intervals. Blowing into a spirometer is an excellent exercise because the patient can watch his gain in vital capacity in that way.

Bronchial fistulæ should not be closed artificially during an acute suppurative process. They frequently act as safety valves for suppuration within the lung; and when their need has ceased they nearly always close spontaneously. Several months should be allowed to elapse before artificial closure of them is attempted.

Chronic empyema should be regarded as a preventable disease. The majority of cases which one sees have been due to causes which may be regarded as preventable. The most common causes are inadequate drainage, too late drainage, too early drainage, and the presence of foreign bodies, including sequestra from ribs. Certain cases, however, are due to a failure of the cavity to become obliterated because of an unavoidable extensive fibrosis and contraction of the lung; others are due to tuberculosis, about 13 per cent, in my own experience. Since the majority of cases are due to improper drainage and foreign bodies, it is well to begin the treatment conservatively by establishing adequate drainage at a proper site and at the same time searching for a foreign body in the cavity. A combination of proper drainage and irrigation for a few weeks will often produce marvelous results in these cases. Hedblom[1] has published an interesting compilation of cases of chronic empyema treated conservatively, showing the remarkable results which may be obtained in the obliteration of the cavities in this way. My own experience has been similar. A careful search for tuberculosis should also be made. Microscopic examination of an excised piece of thickened pleura will often establish the diagnosis when other methods fail.

If a trial of good conservative methods for several weeks or months has failed to produce healing, then various plastic procedures may be instituted. There will be less danger in performing them at this time because the field will have been made much cleaner. The principles involved in these plastic operations are designed to obliterate the cavity and they are in general of three kinds: (1) encouraging the lung to expand to meet the chest wall by loosening adhesions, decortication, etc.; (2) making the soft parts of the chest wall meet the lung by removal of ribs and thickened parietal pleura; and (3) filling the cavity with living tissue such as a muscle flap or a skin flap. The use of pastes of various kinds to plug the cavity is objectionable because frequently the paste passes into the lung and becomes widely disseminated throughout the bronchial tree.

[1] Hedblom, C. A. The treatment of chronic empyema. Ann. Surg. 1920, lxxii, 288.

SURGERY OF THE THORAX[1]

By DALLAS B. PHEMISTER, M.D., F.A.C.S., Chicago

I WANT to limit my remarks to what brings about expansion of a collapsed lung in acute empyema with drainage where stabilization of mediastinum has occurred. This may be the result of three factors:

1. The pull of the contracting granulations on the visceral pleura at its reflection on to parietal pleura as the two layers fuse, and the cavity is gradually obliterated.

2. The positive pressure within the collapsed lung produced by the entrance of air from the opposite side during forced expiration.

3. The negative pressure in the empyema cavity present during inspiration, when the diameter of the drainage opening is smaller than that of the main bronchus on the affected side.

Of the three factors, the pulling out of the lung by the healing granulations is the one of greatest importance. With the establishment of suitable conditions, the empyema wound heals and the cavity is obliterated by granulation tissue and the fusion of its walls.

In acute empyema, there is variation from the ordinary wound with a cavity, in that one-half of its wall is fixed and the other half has to be brought to it. The parietal wall of the cavity is rigid, so that obliteration is accomplished by bringing the visceral wall out in contact with it. Granulation tissue along the line of junction of parietal and visceral pleuræ gradually leads to fusion of the two surfaces and this proceeds toward the drainage opening until the visceral pleura and lung are pulled out and the cavity is obliterated. This is assisted by positive pressure within the lung during forced expiration. If conditions for wound healing are satisfactory, expansion will occur even when the drainage opening in the chest wall is larger than the bronchus on the affected side, so that negative pressure in the pleural cavity is not produced during inspiration. It will also occur then without any special means being taken to increase the positive pressure in the collapsed lung during expiration by forced measures, such as blowing exercises.

To create the most favorable conditions for wound healing and consequently for cavity obliteration, general surgical principles of wound healing should receive first consideration and the special principles applicable to the chest because of pressure conditions, while employed, should receive secondary consideration. Free drainage at the most dependent point is the important factor. The drainage tube should be large, particularly when large deposits of fibrin are present. The tube, reaching just beyond the chest wall into the cavity, should be left in until the cavity is completely obliterated. Chronic empyema almost never results from too large a tube or from leaving in a tube of proper length too long, whereas it is not infrequently the result of too small a tube or of drainage for too short a time. Free drainage does the most toward procuring healthy granulations on the pleural surfaces. Healthy granulations lead to fusion of parietal and visceral pleuræ and obliteration of the cavity. Unhealthy granulations lead to failure of fusion of the two surfaces and to the formation of thickened pleura, which retard lung expansion and tend toward chronic empyema. I doubt very much if anything is accomplished by irrigation of the pleural cavity in acute empyema, except in those cases where there are large amounts of fibrin or in the very exceptional cases where sloughs are present, and then the irrigations do not need to be continued beyond the time of their removal. Fibrin is not nearly as harmful in empyema as some have imagined. It is readily digested by proteolytic ferments liberated by the pus cells, and its presence is an indication either that leucocytes are being poured out in relatively small numbers or that the antiferment content of the exudate is high. Either condition is in general a favorable sign. The special objection to fibrin on the pleura is that, if present during the healing stage, it is partly replaced by granulations, which thicken the pleura.

[1] Read before the Clinical Congress of the American College of Surgeons, Chicago, October 22–26, 1923.

SEVENTEEN LIFE-SAVING BRONCHOSCOPIES IN ONE CASE

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STATISTICS of various hospitals show a mortality ranging from 10 to 20 per cent, and, curiously, this high death rate is attributed to post-tracheotomic pneumonia and in some instances to œdema of the lungs. In some institutions there was a high operative mortality. At the Bronchoscopic Clinic we have had no operative mortality and our postoperative mortality is not over 1 per cent. Postoperative lobar pneumonia has been conspicuous by its absence. Our freedom from operative mortality may be due to the fact that we never use general anæsthesia for tracheotomy. We believe that in dyspnœic cases its use is attended with very high mortality. Our low postoperative mortality we believe, however, is not due so much to the difference in technique of the tracheotomy as to the use of the bronchoscope and of the aspirating tube in the after-care. We are convinced that the supposed pneumonia seen elsewhere is, in most cases, an error in diagnosis. Over and over again we have seen most of the signs and symptoms of pneumonia present in a case and have seen them disappear in a few minutes after removal of obstructing secretions from the bronchi.

Fig. 1. These represent all the crusts removed during the seventeen bronchoscopies. Some of them are of sufficient size to obstruct a large bronchus completely. The signs of the so-called pneumonia cleared up immediately upon removal of the occluding mass of secretion.

The fundamental mechanics of a tracheotomy are these: With the insertion of a tracheotomy tube into the trachea a new airway is established, and the larynx which is the most common seat of obstruction to the normal air current, has been eliminated. In order to maintain its effectiveness, the newly created airway and the tracheobronchial tree beyond this point must be kept open. This requires the attention of a surgical "plumber," whose chief duty is to keep open the air pipes, natural and artificial.

How a realization of these fundamental mechanics can eliminate the symptoms and signs often wrongly interpreted as post-tracheotomic pneumonia is shown by the following report of a case, which, though extreme, is one of many similar cases:

Case No. Fbdy. 1119. Girl, age 2, was admitted to the Bronchoscopic Clinic with a history of choking while eating peanuts on the day previous. A wheezing on expiration had developed immediately.

On admission the temperature was 100.4 degrees F. A distinct asthmatoid wheeze could be heard during expiration. There was moderate dyspnœa. Physical signs indicated obstruction to the middle and lower lobes, right lung. Dr. W. F. Manges, by roentgen-ray examination, localized a non-opaque foreign body in the right stem bronchus. Bronchoscopy by Dr. Chevalier Jackson on the day of admission showed a peanut in the right bronchus which was removed without anæsthesia, general or local, in 1 minute 25 seconds. Marked swelling of the subglottic tissues was noted at this time.

Dyspnœa became progressively worse and a tracheotomy was done, under local anæsthesia (apothesine ¼ per cent), about 5 hours after bronchoscopy. After aspiration of a considerable quantity of thick tenacious pus from the trachea, a No. 2 cannula was inserted. It was noted at this time that the patient made no effort to rid the trachea of blood or secretion by coughing; instead, she fell asleep as soon as the trachea was opened. No anæsthetic had been injected into the trachea to obtund the cough reflex nor sedative given to interfere with the "watch dog of the lungs."[1]

[1]Jackson, Chevalier. Peroral Endoscopy and Laryngeal Surgery. 1914.

TABLE I*

Time	Physical Signs	Procedure	Results
Jan. 27, 1923 10:00 a. m.	Marked diminution of breath sounds over right lower lobe and entire left lung.	Removal of crust from bifurcation and aspiration of secretion.	Free aeration of both lungs.
Jan. 27, 1923 4:00 p. m.	Partial obstruction lower lobe, left lung, and middle and lower lobes, right lung.	Removal of crusts from right bronchus and aspiration of pus from left bronchus.	Airway re-established.
Jan. 27, 1923 11:15 p. m.	Marked air hunger, pallor, restlessness. No air entering entire left lung. Partial obstruction right lower lobe.	Removal of large crust from left main bronchus. Aspiration of pus from both bronchi.	Symptoms did not clear up completely. Right lower lobe cleared. Some obstruction to left lung persisting.
Jan. 28, 1923 3:00 p. m.	Progressive increase of signs of air hunger. Left lung completely closed off. Some interference with right lower lobe.	Removal of crust from left bronchus. Large quantity of secretion aspirated from both bronchi.	Marked improvement of signs and symptoms. Fell asleep immediately. Excellent aeration of both lungs.
Jan. 28, 1923 1:00 p. m.	Recurrence of dyspnœa. Marked obstruction to left lung and to middle and lower lobes, right lung.	Removal of large crust at carina. Aspiration of secretion.	Free aeration of left lung and of middle lobe. Lower right still obstructed.
Jan. 28, 1923 4:30 p. m.	Marked dyspnœa which came on suddenly. Before bronchoscope could be introduced patient became cyanotic, then respirations ceased.	Large crust removed from trachea at carina. Considerable secretion aspirated.	Breathing re-established by artificial respiration. Airway to both lungs opened.
Jan. 28, 1923 10:15 p. m.	Obstruction to left lung and lower right lobe.	Secretion aspirated and a crust removed from right bronchus.	Free aeration of both sides.
Jan. 29, 1923 12:20 a. m.	Entire right lung seems obstructed. Left side clear.	Small crust of secretion removed from right bronchus.	Obstruction of air current to right lung partially removed.
Jan. 29, 1923 4:45 a. m.	Aeration of both lungs interfered with. Marked dyspnœa with ashy pallor.	Large amount of secretion with small fragments of crust removed from both bronchi.	Some improvement in physical signs.
Jan. 29, 1923 8:00 a. m.	Marked obstruction to entire left lung. Partial obstruction to right lower lobe.	Hard, dry crust removed from left bronchus. Secretion from right bronchus.	Free aeration of both lungs.
Jan. 29, 1923 11:45 a. m.	Obstruction to both lower lobes. More marked over the right.	Dry crust removed from right bronchus. Secretion aspirated from both sides.	Marked relief. Spent fairly restful night.
Jan. 30, 1923 10:00 a. m.	Considerable interference, left lower lobe; less over right side.	Small crusts removed from both main bronchi.	Marked improvement over both lungs.
Jan. 30, 1923 4:00 p. m.	No air entering the left lung with some obstruction to right lower lobe.	Large crust removed from left bronchus, considerable secretion aspirated from both sides.	Breath sounds heard very well over both lungs.
Jan. 30, 1923 9:45 p. m.	Entire left lung and lower right obstructed.	Small crust and secretion removed from both sides.	Free aeration of both lungs.
Jan. 31, 1923 5:45 a. m.	The entire left lung seems to be out of commission.	Large crust removed from left bronchus at carina.	Marked relief with improvement of signs over left chest.
Jan. 31, 1923 11:50 a. m.	Some obstruction to entire left lung and right lower lobe.	Aspiration of large amount secretion with removal of many small crusts.	Obstruction cleared up. Return of slight cough reflex.
Jan. 31, 1923 6:00 p. m.	Left bronchus seems completely blocked. The right side is clear.	Aspiration of large amount secretion from left main bronchus.	Left lung clear. Cough reflex more active.

*A 5 millimeter tube was used, and no anæsthetic was given, in the 17 bronchoscopies listed in this table.

Everything went well for about 36 hours when the nurse, long experienced in tracheotomy work, noticed that the child was restless, that the respiratory rate had increased and that there was beginning dyspnœa. The inner cannula was changed with no apparent relief. The child made no attempt to cough nor could the reflex be provoked. Dr. Holzman, the interne in charge of the case, changed the tracheotomy tube. No relief being obtained, he concluded that there was obstruction of the airway beyond the end of the tube and advised bronchoscopy. On examination I found moderate limitation of expansion, slight impairment of resonance and marked diminution of breath sounds over the entire left lung and the right lower lobe. A tracheotomic bronchoscopy was done which showed swollen bronchial mucosa with thick crusted secretion, particles of which were removed with forceps. After the bronchoscope was withdrawn a crust, representing a partial cast of a bronchus, was coughed up. Breathing was greatly relieved and breath sounds could be well heard over the entire chest.

In all, seventeen bronchoscopies were done within 104 hours as noted in Table I. Each was believed indicated because of the progressive development of dyspnœa with moderate indrawing, increased respiratory and pulse rates, pallor and restlessness. At no time was there cyanosis. In addition, examination of the chest revealed one or more lobes, even an entire lung to be partially or completely out of function.

Every effort was made to rid the trachea of secretion in order to avoid further bronchoscopies because it was feared that frequent bronchoscopy, although relieving the obstruction, would exhaust the child.[1]

The tracheotomy tube was changed at very frequent intervals and a flexible aspirating tube was introduced into the trachea to remove secretions. A

[1]Jackson, Chevalier. Peroral Endoscopy and Laryngeal Surgery. 1914.

croup tent with medicated vapor was used. Professor Hare was consulted, with a view of giving internal medication to promote a more copious flow of the bronchial secretion and to stimulate the cough reflex.

With the gradual return of the bechic reflex and a more profuse bronchial secretion, aspiration of the upper trachea through the tracheotomy wound every 2 hours was sufficient to relieve the patient and further bronchoscopy was unnecessary. The two hour interval was gradually lengthened and aspiration was discontinued 3 days after the last bronchoscopy, when the patient was again able to rid the air passages of secretion by spontaneous coughing.

Decannulation, preceded by corking, was done in about 3 weeks, and the patient was discharged apparently well with no evidence of pathology in the chest.

In a review of many of the leading present day textbooks on surgery and laryngology, one still sees frequent reference made to pneumonia as a complication of tracheotomy.

With the clinical picture of limited expansion, impaired resonance, and diminished or suppressed breath sounds over one or more lobes and many râles over the entire chest associated with rapid pulse and respiratory rate and fever, the diagnosis of pneumonia seems justifiable. Unlike pneumonia however, in the case reported these signs were dissipated by bronchoscopic removal of crusts and secretion, and the child, previously restless, slept peacefully until there was a recurrence of the obstruction to the airway sufficient to produce a repetition of the signs and symptoms of air hunger.

Dr. Jackson states that pneumonia is one of the rarest of complications following tracheotomy.[1]

CONCLUSIONS

1. Tracheotomy is a means toward an end. It does not insure a permanently free airway.

2. Close observation and watchful aftercare of every tracheotomized patient is imperative.

3. An increased respiratory rate with signs of dyspnœa rarely mean pulmonary complications and almost never lobar pneumonia.

4. The most common cause of post-tracheotomic dyspnœa is mechanical obstruction to the airway. This may be due to secretion, to an improperly fitting cannula or a cannula which has not been properly placed.

5. Any case of dyspnœa not relieved by changing a properly fitted, clean cannula should have a bronchoscopy done to see why the air is not getting down into the lungs.

6. Obstructive dyspnœa is impossible when the tracheotomy tube and the tracheobronchial tree are patulous.

7. A bronchoscope and a mechanical aspirator should be at the bedside of every tracheotomy case. These may be the means of saving life in any case.

8. In the cases of total absence of the cough reflex often seen in children after tracheotomy, the patients will all die unless the secretions are removed mechanically.

[1]Jackson, Chevalier. Peroral Endoscopy and Laryngeal Surgery. 1914.

PAPILLOMATA INVOLVING THE FEMALE URETHRA

By HENRY A. R. KREUTZMANN, M.D., San Francisco, California

VERY little mention has been made of true papillomatous growths of the female urethra without involvement of any other part of the urinary tract. During the past 2 years, however, innumerable such cases have come to my attention, and I have found that the growths are most common in patients suffering from a chronic infection of the urinary tract.

That the female urethra in the past was considered a relatively unimportant structure no doubt accounts for the fact that more frequent and thorough urethroscopic examinations with water-dilating cystoscopes have not been made, and the result has been that this condition is often overlooked.

LITERATURE

Many references are found in the literature to polypi and papillomata of the female urethra. Most of them, however, refer to the caruncle which occurs at the meatus and is not classified as a true papilloma.

In the days before cystoscopy, only when the growths had attained sufficient size to protrude from the urethra and had become visible to the eye were they noted.

Bullock (1), in 1893, described a case in which the tumor protruded from the vulva. It was attached to the posterior half of the meatus urinarius. It was 2 centimeters in length, lobulated, dry, elastic, and painless. He stated that the patient refused to have it removed, fearing that she might not be able to pursue her vocation as washerwoman.

Desguin (2) reported a case of a girl of 17 who had a growth protruding from the vulva which resembled an inverted uterus. The growth was fastened to the right side of the urethra. The urethra itself was so greatly dilated that digital examination was possible. A second growth was palpated higher up on the left side of the urethra near the bladder neck. The patient also had complete incontinence. The growths were removed with a wire snare.

Luys, in his book on *Cystoscopy and Urethroscopy* (3), states that at times one finds well developed polypi in the urethra of the female. He divides the urethra into two distinct anatomic parts: the posterior part which adjoins the neck of the bladder and is entirely muscular in structure; and the anterior part which contains an abundance of glandular orifices. Luys believes that the existence of these glands is probably responsible for the tendency of the gonococcal infection to persist in the female urethra; they may also account for the frequent development of polypi at the external orifice of the urethra.

Pederson (4) states that fibrous polypi are by no means uncommon in the female urethra and may enlarge, elongate their pedicles, and by muscular action present at the meatus exactly as does a uterine polyp at the external os.

SYMPTOMS

This paper is based on 40 cases in which multiple papillomata were demonstrated in the urethra with no associated growths elsewhere in the urinary tract. As yet, we have never met with a case in which a papilloma was seen protruding from the meatus. Contrary to the statement of Luys, the growths observed in this series of patients occurred in the posterior urethra.

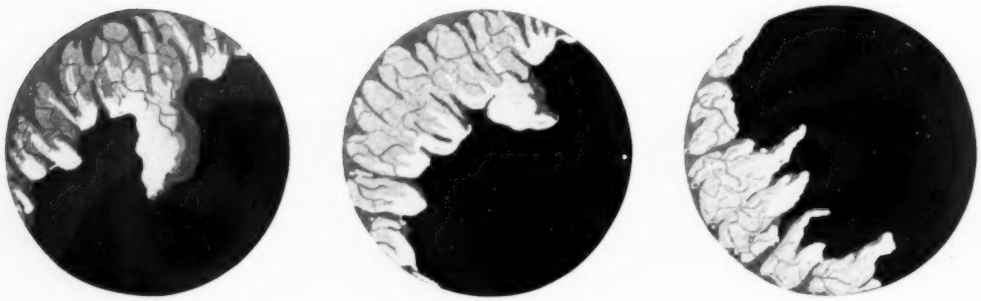
As most of the patients in whom this condition was found had other lesions of the urinary system, it is difficult to say whether or not their symptoms were due to the papillomata or to the co-existing pathology.

Although these growths may attain considerable size, only one patient of the entire number complained of any symptoms amenable to that of obstruction. The most common complaints in the order of frequency were: frequent urination, nocturia, dysuria, urgency, and hesitancy.

Only 50 per cent of the cases showed pus cells in the catheterized specimens of bladder urine. The same number gave positive cul-

a. *b.*

Fig. 1. Papilloma as seen through the Buerger urethroscope. Note the position of the growths on top of the folds of mucous membrane.



a. *b.* *c.*

Fig. 2. Papilloma as seen with Buerger posterior cystoscope. A large villous growth is shown with part of the bladder neck beyond.

tures. Bacillus coli was the most common organism found.

In 42 per cent of the cases there was a history of previous cystitis, which in some patients had lasted for many years and in others had recurred intermittently up to the time of examination.

DIAGNOSIS

This cannot be made from the symptoms, but only by direct examination. In the entire series there was no case in which any growths were visible at the meatus. It was only after careful search of the urethra that the papillomata were found.

The best instruments to use are water-dilating cystoscopes equipped with a lens system, such as the posterior Buerger or McCarthy cystoscopes or the Buerger or Geringer urethroscopes.

The growths were found to be most frequent on the anterior and lateral walls of the posterior urethra, just outside of the vesical sphincter. They were so close to the bladder that by moving the eyepiece of the cystoscope to the extreme right or left side of the patient the papillomata projected into the urethra and were plainly visible against the dark background of the bladder.

The growths were not sessile, but were villous in shape, whitish to pink in color, with a fine blood vessel along the periphery.

They varied in number from two or three to cases in which the entire wall was covered. They did not extend along the entire urethra, but seemed to be limited to a distinct zone beginning just external to the vesical sphincter and extending for approximately half a centimeter toward the anterior urethra.

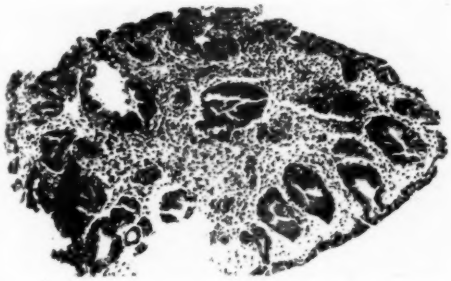


Fig. 3. Photomicrograph of a single papilloma, under low power.

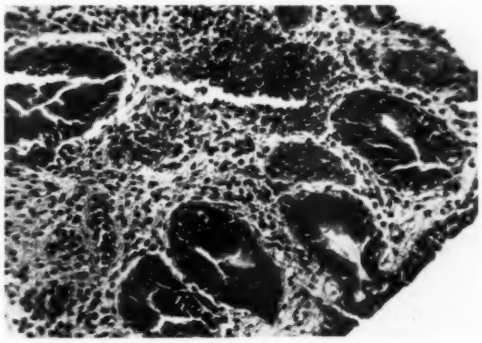


Fig. 4. Section of a growth under high power.

The picture obtained with a cystoscope is quite different from that seen with a urethroscope. With the cystoscope, the lens is close to the growths, flattening them out. As their color is similar to that of the surrounding mucosa, it is sometimes difficult to see them, except by moving the outer end of the instrument sharply to one side so as to make an acute angle with the wall of the urethra. With the urethroscope, the mucosa appears striated with the lines running parallel with the instrument; a picture similar to that seen in that part of the male urethra lying between the internal sphincter and the verumontanum. The papillomata now appear as fingerlike projections pushing from the sides toward the lumen of the canal. It is then observed that they originate from the crests of the rugæ, and it is sometimes difficult to distinguish them from the heaped up mucosa on the tops of the ridges.

TREATMENT

After anæsthetizing the urethra, the larger growths were removed with the cystoscopic rongeur and their bases fulgurated.

In cases in which multiple small growths occurred, the high frequency current alone was used. It was necessary to be careful not to burn too deeply in order to prevent a large slough with subsequent scar-tissue formation.

The patients returned after 6 to 8 weeks. If a second examination showed any remaining growths, the high frequency current was again applied.

PATHOLOGY

In a number of cases in which the growths were removed with the rongeur, sections were made and examined microscopically. The pathological report was made by Dr. W. T. Cummins, pathologist at the Southern Pacific Hospital. The findings in the various cases were very much the same. The following is a characteristic picture of the pathology present:

Mrs. J. G. No. 79362. There is an irregular thickening of the epithelial margin, while the underlying tissues are made up in the major part of a dense round cell infiltrate and some mucous tissue with plasma cells. There are a few small "pearls" near the margin of the tissue. Epithelial mitotic figures are not conspicuous. Blood vessels are few in number, congested, and their walls are thin. There are scattered areas of hæmorrhagic infiltration.

DISCUSSION

After having observed a large number of women in whom papillomata were present, the conclusion is reached that the growths themselves cause few if any symptoms. Their importance lies in the fact that when they are present, some pathological condition is to be found somewhere in the urinary system. They are a signpost pointing to trouble somewhere along the line.

In the forty cases under review, 87.5 per cent showed urinary pathology as follows:

	Per cent
Cystitis (including pyelitis 7%)..	50
Stricture of the ureter.....	15
Stricture of the urethra.....	8
Gonorrhœa (chronic).....	7.5
Renal calculi.....	7

In the remaining 12.5 per cent of cases we believe either that the diagnosis was missed or that the condition causing the formation of the papillomata had been removed before the patient came for examination.

These growths are the result of a long-continued irritation to the mucosa, usually bacterial in origin. Therefore one may expect to find that the lesion present is due to some organism invading the urinary tract. However, that does not mean that every case of urinary infection shows the presence of papillomata in the urethra.

It is only in the chronically infected cases that one may expect to find these growths. We have noted that so far in none of the cases of kidney and bladder tuberculosis diagnosed during the past 2 years, has this condition been present.

CONCLUSIONS

Papillomata are quite common in the female urethra.

They occur most often in the posterior portion, just external to the vesical sphincter.

They are the result of a chronic inflammation of some part of the urinary tract.

In themselves they cause few symptoms. Their importance lies in the fact that when present, they are indicative of long standing pathology somewhere in the urinary system.

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LYMPH GLANDS IN CARCINOMA OF THE SMALL INTESTINES

A Review of the Condition of the Glands in Carcinoma of the Gastro-Intestinal Tract[1]

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THE incidence and degree of metastatic involvement of regional lymphatics in cases of carcinoma has long been recognized as an index to the extensiveness of the lesion, as well as an aid in prognostication. Anatomists, embryologists, and physiologists have shown that the gastro-intestinal tract has a definite and well-organized lymphatic drainage, following certain anatomic lines and having definite terminations. Intensive studies of series of cases of carcinoma have been undertaken because of the dissemination of carcinoma through the lymphatic system, and the regional lymph glands, the point of initial metastasis.

RELATIVE INCIDENCE OF THE DISEASE

Carcinoma of the small intestine is rare, and the symptoms of stenosis lead to the recognition of the disease. Combining the statistics of Maydl, Nothnagel, Zerman, Mueller, and Bryant, it is seen that of 659 cases of intestinal carcinoma that have been collected, the carcinoma was in the small intestine in 6.22 per cent. The statistics of Maydl, Nothnagel, and Mueller show that of the twenty-six cases of carcinoma of the small intestine, the carcinoma was in the duodenum in thirteen, and the remaining thirteen were in the ileum and jejunum. Other statistics indicate that a greater majority of the lesions are located in the duodenum. Rolleston has collected fifty-four cases of primary carcinoma of the intestines, and only nineteen were in the ileum and jejunum.

In 1919, Judd reported twenty-four cases of primary carcinoma of the small intestine, five being in the duodenum, eleven in the jejunum, six in the ileum, and two cases of multiple lesions occurring in different parts of the small bowel. He attributed the discrepancy between figures regarding the anatomic distribution of malignancy in cases observed at the Mayo Clinic and elsewhere, to the fact that the Mayo Clinic statistics were compiled from data taken at the time the patients were treated, whereas statistics from other clinics were based on postmortem findings.

Since 1907, in the Mayo Clinic, 4,684 patients with gastro-intestinal carcinoma have been operated on, and the condition verified pathologically. The growth was in the stomach in 2,544 instances, in the small intestine in thirty-six, in the colon in 362, in the cæcum in 135, in the rectosigmoid in 377, in the sigmoid in 293, and in the rectum in 937.

PORTIONS OF THE GASTRO-INTESTINAL TRACT PREVIOUSLY STUDIED

Carcinoma of the stomach. MacCarty and Blackford in 1912 in studying the incidence of the involvement of the regional lymphatics in carcinoma of the stomach, found metastatic involvement in 52 per cent of the glands. They completed a study of 200 cases with 1,040 associated glands. The average age of the patients was forty-eight years; the average duration of symptoms was eight years. Males predominated, there being 74 per cent males and 27 per cent females. The resected specimens contained from one to fifteen lymph glands, varying in size and appearance, and necessitating microscopic examination, for it had previously been observed that large as well as small glands may be involved.

Carcinoma of the large bowel. Third in relative occurrence of carcinoma of the gastro-intestinal tract is carcinoma of the large bowel. Hayes, in 1921, has reviewed 100 such cases and 1,406 glands. Included in his series were the ascending colon, hepatic flexure, transverse colon, splenic flexure, and descending colon to and including the sigmoid. The average age of patients was fifty-seven years, the average duration of symptoms nine and six-tenths months. The number of males and females was equal. The associated regional glands were involved in 37 per cent of the

[1] From the Section on Surgical Pathology, Mayo Clinic.

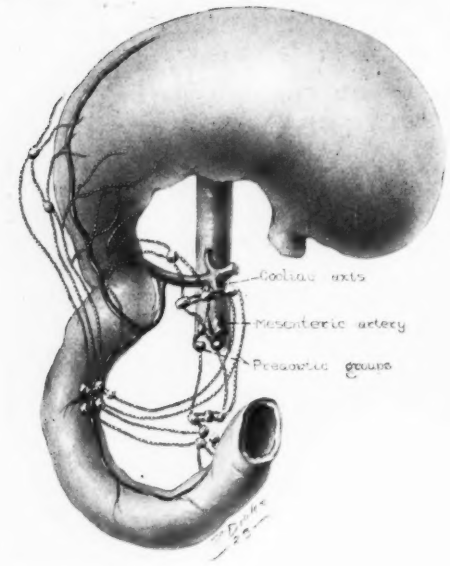

Fig. 1. Schematic diagram of lymphatic vessels and glands of stomach and duodenum, demonstrating their interrelationship and general plan of position.

cases. The relative frequency of malignacy is the reverse of the anatomic arrangement of the bowel; there were forty-two cases of carcinoma of the sigmoid, twenty-one of the descending colon, seven of the splenic flexure, sixteen of the transverse colon, nine of the hepatic flexure, and five of the ascending colon.

Carcinoma of the rectum. McVay, in 1922, in reviewing 100 cases of rectal carcinoma and 623 associated lymph glands for metastatic involvement, found that 47 per cent of the glands were carcinomatous. The average age of the patients was fifty and eight-tenths years, and the average duration of symptoms was ten and four-tenths months. As in cases of carcinoma of the stomach, males predominated; 57 per cent of the patients were males, and 43 per cent females. Here also it was found that the size of the lesion and the number of enlarged regional glands were no criterion of the incidence of metastatic involvement, for with a large intestinal lesion there might be extensive involvement or none, while with a small lesion of a greater or lesser degree of

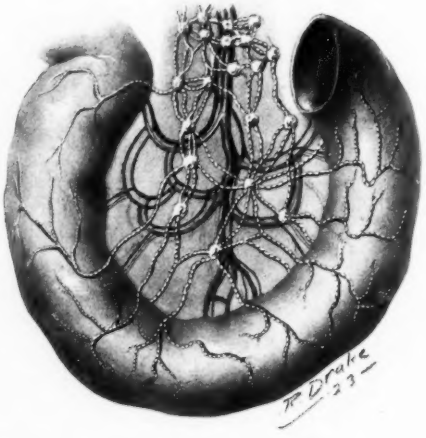

Fig. 2. Loop of small intestine showing the relationship of mesentery, lymphatics and blood vessels.

malignancy, the percentage of involvement might be more or less.

Carcinoma of the cæcum. One hundred specimens with 1,033 glands were examined by MacCarty and Craig in 1923. There was metastatic involvement of 32 per cent of the regional lymph glands. The average age of patients was forty-eight years, and the duration of symptoms was nine and two-tenths months. Sixty-six per cent were males, and 34 per cent females.

PRESENT STUDY

Carcinoma of the small intestine. A review of the pathological material and clinical records of these cases demonstrated that it would be difficult to follow exactly the method pursued in the preceding studies. Whereas in the other portions of the gastro-intestinal tract the lesions had all been primary, certain of those in the small intestines were secondary, and a few were indeterminate. By "indeterminate" is meant that a part of the pathological material proved to be associated with malignancy elsewhere in the bowel or peritoneal cavity, but such cases showed definite glandular involvement and were used to complete the percentage of incidence of metastasis. In view of this fact the cases were divided into

Fig. 3. Lymph gland showing metastasis from a colloid carcinoma.

Fig. 4. Malignant papillomatous neoplasm which caused obstructive symptoms and ultimate intussusception.

groups, the first comprising those which were definitely primary carcinomata, and the second, those which were secondary or indeterminate. There were thirty-six cases, and forty-five associated regional lymphatic glands. The first group was further divided into the anatomic units of the small intestine; and the duodenum, jejunum, and ileum were regarded as separate units.

The lymphatics of the small intestine arise in the villi, and form mucous, submucous, muscular, and subserous plexuses. The lymph vessels of the duodenum follow the course of the blood vessels. From the anterior surface, lymph vessels pass along the course of the inferior pancreaticoduodenal artery, and communicate with the lymph glands along the course of that vessel; thence they pass to the inferior celiac glands beside the origin of the superior mesenteric artery. The vessels from the posterior aspect accompany the superior pancreaticoduodenal artery, communicate with the inferior gastric glands, and terminate in the celiac glands. Figure 1 is a schematic diagram of the lymphatic vessels and glands; the stomach is reflected upward, allowing the association of the lymphatics of the stomach and the duodenum to be demonstrated. The lymph vessels of the jejunum and ileum ascend between the two layers of the mesentery, and enter the mesenteric glands which are situated mainly along the course of the blood vessels at various intervals. The vasa efferentia from these glands form the truncus intestinalis which ends in the cisterni chyli. Figure 2 illustrates the lymphatic drainage of the jejunum and the ileum.

Carcinoma of the duodenum was found in six of the thirty-six cases, and in only one of these was an operative specimen available. This proved to be a malignant papilloma; there was no associated glandular involvement. In order to reach a conclusion with regard to the incidence of glandular involvement, the postmortem specimens of four cases were examined; all proved to be accompanied by metastatic lymph glands. The appearance of these specimens seemed to indicate that metastasis had occurred to the regional glands in the other cases. The type of malignancy in all cases was adenocarcinoma of the cylinder-cell variety, and the lesions, constricting in type, were obstructing the lumen.

There were twelve cases of carcinoma of the jejunum, and glands were obtained from the operative specimens of all but one, in which exploration revealed inoperable malignancy. The only colloid carcinomata encountered were in the jejunum; there were three such cases (Fig. 3). In only one of the cases in which the bowel was resected with the associated glands, were the glands found to be inflammatory; the condition had metastasized to all of the other glands. This is not explained by the greater degree of malignancy of the neoplasm in this region, but by the fact that in nearly every case the symptoms were obstructive. Before the lesions became ob-

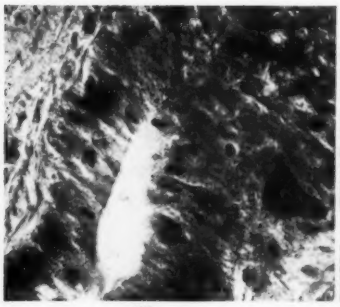

Fig. 5.

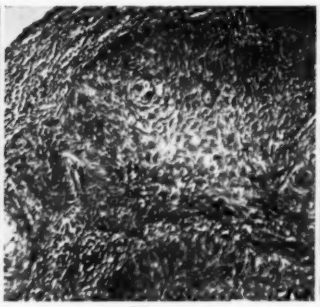

Fig. 6.

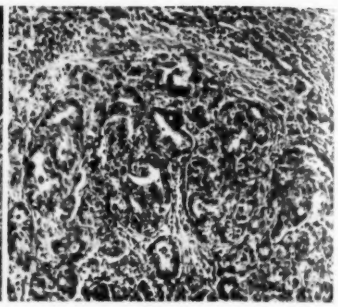

Fig. 7.

Fig. 5. Microscopic section of case shown in Figure 4, demonstrating mitotic figures and undifferentiated epithelial cells.

Fig. 6. Gland from mesentery showing squamous-cell epithelioma associated with malignant obstruction of the ileum, secondary to malignancy of the cervix.

Fig. 7. Mesenteric lymph gland from jejunum showing type of metastasis of gastro-intestinal carcinoma.

structive, they must have advanced in size and extent far beyond that of other malignancy in the gastro-intestinal tract. Hence we see a higher degree of metastatic involvement. The average duration of symptoms was only five months.

The postoperative longevity was fair; the patients lived from two months to eight years after resection. When anastomosis around the lesion only was performed, the patients lived from one month to two years.

Primary carcinoma of the ileum occurred in eight cases, in seven of which resection was performed. However, glands were obtained from only three; microscopic examination revealed carcinomatous involvement in two, and inflammation in one. The glands were evidently not removed with the specimen in the other cases. Here, as in the preceding series, the average duration of symptoms was short, and the postoperative mortality high, which may possibly be explained by the late appearance of symptoms, and the advancement of the growth. In all but one case in this region, the malignancy was of the adenocarcinomatous constricting type. The one exception was a malignant papillomatous neoplasm, the gross and microscopic aspects of which are shown in Figures 4 and 5. This papilloma caused intussusception, and was excised.

The cases which could not be identified with the primary carcinomata of the small intestine will be considered as a separate group and discussed individually. With one exception, these secondary lesions occurred in the ileum, probably owing to the fact that the ileum is in closer proximity to the primary lesions. It seems probable that the secondary lesions are due to extension rather than true metastasis through the lymphatics. Some of the patients were operated on, and the primary and secondary lesions removed together. In other cases, the secondary lesions became prominent at a later date, after the primary source had been eliminated by operation.

ABSTRACTS OF CASES

CASE 27. (A68010.) Illustrates the type of case in which the recurrence appears a year after the primary operation. An exploratory operation for carcinoma of the cæcum was performed, and the malignant tissue removed. There was no trouble for a year, when obstructive symptoms manifested themselves, and on opening the abdomen a carcinoma of the ileum was found. There was marked glandular involvement, and one of the glands was removed for confirmation of the diagnosis. Microscopic examination revealed definite carcinoma.

CASE 28. (A249774.) Illustrates an unusual condition. The patient was a woman aged fifty-five years, who came to the Clinic for malignancy of the cervix. An inoperable epithelioma of the cervix was found. Radium treatment was instituted and her condition improved. Six months later she returned with symptoms of obstruction, and on exploration, multiple constricting lesions of the ileum were found. A lymph gland was removed for diagnosis and gave evidence of typical squamous-cell epithelioma (Fig. 6).

CASE 29. (A143252.) Illustrates another method of secondary metastasis to the ileum. This was a case of intracystic papillary adenocarcinoma of the ovary, which had invaded the small intestine. The mass was removed and the glands showed metastatic involvement.

CASE 30. (A136413.) A man, age 32 years, had carcinoma of the sigmoid which invaded and involved the ileum. Both growths were excised at the same operation. The glands were inflammatory.

TABLE I.—CARCINOMA OF THE GASTRO-INTESTINAL TRACT

Lesion	Average age	Predominating sex	Specimens	Glands	Percentage of glands involved	Average duration of symptoms, months	Immediate hospital mortality, per cent	Total cases 1907 to 1922
Stomach	48	Male	200	1404	52	96	12	2544
Small intestine	48.3	Male	36	45	66	5.4	33.3	36
Large intestine	52	Male	100	1406	37	8	....	655
Cæcum	48	Male	100	1033	32	9.2	16	135
Rectum	50	Male	100	623	47	10.4	....	1314

TABLE II.—FINDINGS IN SIX CASES OF PRIMARY CARCINOMA OF THE DUODENUM

Case	Sex and age	Duration of symptoms, months	Diagnosis and operation	Pathological diagnosis	Subsequent history
1 (A24217)	M 57	1.75	Carcinoma of entire duodenum. Palliative gastro-enterostomy		Death in two months
2 (A61097)	M 39	12	Malignant papilloma. Resection		Lived two years
3 (A163558)	M 58	5	Carcinoma of first part of duodenum and pancreas	Postmortem examination of glands revealed carcinoma	Lived fourteen days
4 (A143715)	M 59	15	Carcinoma of first part of duodenum; inverted common duct; inoperable	Postmortem examination of glands revealed carcinoma	
5 (A201423)	M 58	12	Exploratory operation; inoperable carcinoma of stomach and duodenum	Postmortem examination of glands revealed carcinoma	
6 (A349258)	M 69	3	Carcinoma of the terminal portion of duodenum	Postmortem examination of glands revealed carcinoma	Lived three days

TABLE III.—TWELVE CASES OF PRIMARY CARCINOMA OF THE JEJUNUM

Case	Sex and age	Duration of symptoms, months	Operation	Pathological diagnosis	Length of postoperative life, months
7 (A710)	M 39	3	Resection of jejunum	Inflammatory gland	14
8 (A20434)	M 40	3	Anastomosis for obstruction	Carcinoma	1
9 (A25214)	M 49	6	Exploration; inoperable	No glands	1
10 (A68893)	F 46	9	Anastomosis for obstruction	Carcinoma	6
11 (A85886)	M 43	4	Anastomosis for obstruction	Carcinoma	24
12 (A86605)	M 57	4	Exploration; inoperable	Carcinoma	2 (days)
13 (A134048)	M 44	6	Resection of jejunum	4 glands; carcinoma	4
14 (A151015)	F 34	6	Resection of jejunum	2 glands; colloid carcinoma	9 (days)
15 (A159902)	M 45	1	Resection of jejunum	2 glands; carcinoma	2
16 (A189091)	M 35	12	Anastomosis for obstruction	Carcinoma	
17 (A375159)	M 48	1	Anastomosis for obstruction	Colloid carcinoma	12
18 (A259360)	M 56	12	Anastomosis for obstruction	Carcinoma	18 (days)

TABLE IV.—EIGHT CASES OF PRIMARY CARCINOMA OF THE ILEUM

Case	Sex and age	Duration of symptoms, months	Operation	Pathological diagnosis	Length of postoperative life, days
19 (A907)	M 48	4	Resection of ileum	No glands	
20 (A2263)	M 53	6	Resection of ileum	1 carcinomatous and 2 inflammatory glands	8
21 (A9420)	F 44	1.25	Resection of ileum. Malignant papilloma. Intussusception	No glands	14 (years)
22 (A36824)	F 44	3	Resection of ileum	3 carcinomatous glands	5
23 (A88325)	M 54	5	Exploration; inoperable carcinoma	No glands	
24 (A250604)	M 47	2	Resection of ileum	No glands	2
25 (A154438)	F 56	3	Resection of ileum	2 inflammatory glands	6
26 (A308263)	F 43	6	Resection of ileum	No glands	90

TABLE V.—CARCINOMA OF THE SMALL INTESTINE

Case	Sex	Age	Duration of symptoms, weeks	Pathological diagnosis
1 (A24217)	M	57	7	
2 (A61097)	M	39	48	
3 (A163558)	M	58	20	Carcinoma
4 (A143715)	M	59	60	Carcinoma
5 (A201423)	M	58	48	Carcinoma
6 (A349258)	M	69	12	Carcinoma
7 (A710)	M	39	12	Inflammatory glands
8 (A20439)	M	40	12	Carcinoma
9 (A25214)	M	49	24	
10 (A68893)	F	46	36	Carcinoma
11 (A85886)	M	43	16	Carcinoma
12 (A86605)	M	57	16	Carcinoma
13 (A134048)	M	44	24	Carcinoma
14 (A151015)	F	34	24	Carcinoma
15 (A159902)	M	45	4	Carcinoma
16 (A180091)	M	35	48	Carcinoma
17 (A375159)	M	48	4	Carcinoma
18 (A250360)	M	56	48	Carcinoma
19 (A907)	M	48	16	
20 (A2263)	M	53	24	Carcinoma
21 (A9420)	F	44	5	
22 (A36824)	F	44	12	Carcinoma
23 (A88325)	M	54	20	
24 (A250604)	M	47	8	
25 (A154438)	F	56	12	Inflammatory glands
26 (A308263)	F	43	24	
27 (A68010)	M	48	52	Carcinoma
28 (A249774)	F	55	24	Carcinoma
29 (A143252)	F	49	28	Carcinoma
30 (A136413)	M	32	36	Inflammatory glands
31 (A95455)	M	49	52	Carcinoma
32 (A61902)	F	51	28	Carcinoma
33 (A206466)	F	48	8	
34 (A225884)	M	35	24	Carcinoma
35 (A241941)	M	47	12	Carcinoma
36 (A313671)	F	42	28	Carcinoma

Average age of patients was 48.3 years
Average duration of symptoms was 5.4 months
Sixty-six per cent of the patients had involvement of lymph glands
Incidence was greatest in men

CASE 31. (A95455.) A man, age 49 years, had carcinoma of the sigmoid. The growth had been excised, and one year later, obstructive symptoms justified an exploratory operation. Carcinoma of the ileum was found, and was excised with the adjacent lymph glands. Five glands were dissected out, and three of these were found to be malignant. The patient lived one year.

CASE 32. (A61902.) A woman, age 51 years, had had obstructive symptoms for three months. Operation revealed a malignant mass containing a portion of the ileum, sigmoid, and uterus. This was excised and three mesenteric glands were found adjacent to the ileum, one of which was inflammatory, and the other two malignant. The primary lesion could not be determined.

CASE 33. (A206466.) A woman, age 48 years, had had definite symptoms for two months and gradual enlargement of the abdomen. A malignant mass was found in the pelvis, and to it was attached the ileum. Examination of the mass revealed the fact that it was an epithelioma in a dermoid cyst; no glands were involved.

CASE 34. (A225884.) A man, age 35 years, had primary carcinoma of the sigmoid. The growth was excised, and the patient apparently recovered. Obstructive symptoms developed in six months, and at operation a mass was found in the ileum. A gland, removed for diagnosis, showed malignancy, and an anastomosis was made around the lesion. The patient lived four months.

CASE 35. (A241941.) A man, age 47 years, came to the Clinic with obscure obstructive symptoms. The operation revealed multiple lesions of the jejunum, and examination of a gland removed revealed typical melano-epithelioma. It was later ascertained that a mole had been removed from the back three months before the onset of symptoms.

CASE 36. (A313671.) Is of especial interest. A woman, age 42 years, came to the Clinic with obstructive symptoms. On opening the abdomen, multiple lesions of the ileum were found. A gland removed for diagnosis proved to be carcinomatous, and an anastomosis around the growth was made (Fig. 8). The patient lived in comparative comfort for one and one-half years.

SUMMARY

There was glandular involvement in twenty-three (36 per cent) of the thirty-six cases of carcinoma of the small intestine. Eighty and seven-tenths per cent of the patients were males. The average age of the patients was

forty-seven and five-tenths years. The average duration of symptoms was five and four-tenths months. Each case averaged one and twenty-five hundredths glands.

Although resection of the bowel with all associated glands is the operation of choice, and produces the best postoperative results, yet anastomosis around the lesion results in a high percentage of postoperative longevity.

In considering the three anatomic divisions of the small intestine with regard to postoperative progress, in cases of carcinoma, it was found that the prognosis is most favorable in cases in which the lesion is in the jejunum. The hospital mortality was the least, and the percentage of longevity greatest in these cases. Lesions of the duodenum are not only difficult to eradicate, but by the time they become manifest, they are so advanced that ablation is impossible. There seems to be a high hospital mortality from lesions of the ileum. The only patient living any length of time had a malignant papilloma which was extirpated, and there was no glandular involvement. Carcinoma of the small intestine is the least common form of gastro-intestinal malignancy. The majority of patients are between 40 and 60 years of age. The most common site of primary malignant neoplasm in our series was the jejunum, which contained 46 per cent of the carcinomata.

The size of the growth in the small intestine cannot be relied on as an accurate index of the probable lymphatic involvement; neither can the history or duration of symptoms indicate the extent of metastasis.

Metastatic involvement of the lymph glands can be definitely determined only by systematic microscopic study of all regional lymph nodes. The size of the lymph node or the number of palpable glands has been proved not to be an index to the amount of involvement.

The microscopic study of the associated glands in this series has been of further diagnostic value in determining the type of malignancy, especially in the cases which were secondary to malignancy elsewhere in the body.

Adenocarcinoma is present in all primary carcinomata of the small intestine, but the possibility of the growth being secondary must be kept in mind.

Malignancy of the small intestine may simulate the primary type, and on microscopic examination prove to be secondary, as is illustrated by the cases of melano-epithelioma and squamous-cell epithelioma, as well as by ovarian and uterine malignancies. Therefore, it is only by systematic microscopic examination that it is possible to rule out local metastasis in cases of carcinoma of the small intestine. A further important object of microscopic study is the determination of the type of malignancy, which is an index as to the primary or secondary nature of the growth, and as such, assists in the prognostication.

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UNILATERAL POLYCYSTIC KIDNEY

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UNILATERAL polycystic kidney is a very rare finding. The case reported in this paper should be entitled "Clinical Unilateral Polycystic Kidney" for no one can state with certainty the condition of the opposite kidney. The infrequency of this unilateral entity is convincing in the following reports. Preitz in the pathological institute of Kiel, in a series of 10,000 autopsies, found but 16 cases of unilateral disease. Seiber found 9 cases of unilateral disease in 149 cases of polycystic condition. The Boston City Hospital found 10 cases in 10 years in a series of 2,500 autopsies. Le Jars found only 2 cases among 63 adult polycystic kidney conditions. Ritchie found 2 unilateral cases in 72 patients.

In the literature it is difficult to find case reports of unilateral disease where the affected kidney is nephrectomized. There may be more of this kind of case in different urological clinics, and it is hoped that such will be reported for statistical purposes. At best these cases are rather difficult to diagnose and most often the diagnoses are made at the operating table or in the course of routine autopsy. While the clinical picture of bilateral polycystic kidney is fairly well defined, that of the unilateral condition is not characteristic. The unilateral disease can easily be confused with any other surgical condition that affects the kidney.

Unilateral polycystic kidney, as in the bilateral polycystic condition, consists of multiple cysts scattered through the kidney immediately beneath the capsule, so that the tumor often has a lobulated appearance. The tumor rather preserves the shape of the normal kidney, but the surface is rough and irregular because of the superficial cysts. The color varies from greyish to a reddish or a light yellow and brown. The contained fluid is either thin and transparent, turbid, viscid or of a brown colloid color. In larger cysts the fluid may be serous with more or less blood, fat, and cholesterin. The cysts are separated by fibrous tissue or by renal parenchyma, which has undergone pressure atrophy and interstitial nephritis, especially in the region of larger cysts. There is usually associated with this a dilatation of the renal pelvis and a thickening and kinking of the ureter. The size of the tumor mass varies from that above the normal size of the kidney to about 16 inches long. In the case reported in this paper, the tumor was rather longer and larger than a football. When cut in the long diameter numerous cysts were revealed with an escape of brown gelatinous material; practically no parenchyma was left. The affected side is usually the left. The disease usually occurs between 35 and 60 years of age, though numerous pathologists feel that the condition is probably congenital. In the case to be reported the condition must have been latent and dormant for many years. Heredity seems to be a predisposing factor in some families. A careful family history of the case reported herein, revealed no symptoms of kidney disease in any other member. Osler reported five children of one mother with this disease. R. H. Crawford mentions numerous cases of polycystic kidney in a family tree of four generations. Borelius reports three cases of bilateral polycystic kidney in the same family. J. K. Love and Richmond report recurrences in one family. Flinterman reports polycystic kidneys in two sisters.

The pathogenesis of this condition is still a matter of theoretical speculation. There are the so-called congenital and adult types of the disease. Developmental defects of the kidney and interstitial inflammation of the kidney have been considered causative factors. But some stress the theory of malformation. Still others think that the cyst formation is due to occlusion of the urinary tubules. The duration of the condition is always hard to estimate.

Microscopically, there is a thin cyst wall lined with epithelium. Often there are large numbers of epithelial cells in the contained fluid. The fibrous tissue varies in density. The tubules and the malphigian corpuscles undergo different changes, from slight dilatation to cyst formation. At times foci of leuco-

cytic infiltration are found and may be the cause of small abscesses. The associated lesions with unilateral polycystic kidney may be: hypertrophy of the heart, arteriosclerosis, cyst formation of the liver, meningocele, supernumerary digits, talipes, cleft palate, imperforate anus, congenital urethral stricture with bilateral hydronephrosis, and cysts of the ovaries and the epididymides.

The symptoms are divided by Kidd into three stages:

1. The latent stage or stage of progressive enlargement of one or both kidneys without other symptoms. This may last from a few months to several years and may be discovered in the course of abdominal palpation.

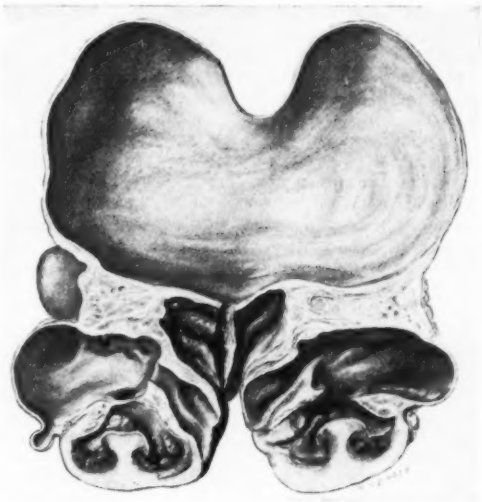
2. The stage of renal tumor and tumor mass. In this stage there may be no pain or a dull ache in the loin, or local pain and tenderness. Hæmaturia often occurs and is due to a rupture of blood vessels in the cysts. If blood clots are passed out through the ureter, colic-like pains are experienced. Kinking of the ureter causes urinary stasis with pain; and in time hydronephrosis develops. Symptoms of decreasing renal function such as nausea, vomiting, flatulence, constipation, and headache are experienced. There is a polyuria with low specific gravity.

3. The stage of uræmia.

Diagnosis of unilateral polycystic kidney is always puzzling. The condition can, at best, be only conjectured after various other surgical affections of the kidney have been ruled out. Cystoscopic and X-ray diagnoses are not of much value in this condition. The palpation of a tumor mass together with signs of failing kidney function, and the good fortune of having seen such a condition, should lead one to suspect polycystic kidney. As has been mentioned previously, the discovery of this type of case is usually a matter of surprise either at the operating table or during an autopsy.

TREATMENT

In unilateral disease nephrectomy is the only rational measure. Life can thus be prolonged for many years if the opposite kidney is not involved. Other surgical procedures like decortication, puncture of the cysts as introduced by Rovsing, and partial nephrectomy have been advanced; but none of these is advisable or practical. If by cystoscopic examination and other tests the kidney function of the opposite side is normal or compensatory, the diseased kidney should be entirely removed. This avoids unnecessary subsequent surgical procedures.



This drawing represents the appearance of tumor, cut in the long diamenter. Lower half of tumor shows numerous collapsed cysts.

CASE REPORT

O. W. male, aged 30, was admitted into Broad Street Hospital, New York, on June 19, 1922. The chief complaints on admission were: general malaise with high temperature and chills; continuous dull pain in the left loin and left half of the abdomen, the pain radiating toward the pubis. Urination was frequent but with no pain or hæmaturia. Four days prior to admission to the hospital he was cystoscoped at another clinic. The following day chills with high fever and the loin pain set in. When he was first seen, a large tumor mass similar to the enlarged spleen in spleno-myelogenous leukæmia was palpated. The lower edge of the tender mass extended below the crest of the ilium. He was advised to enter the hospital for further study, and was under observation for 4 days during which time there was no subsidence of the acute symptoms. The possibility of unilateral polycystic kidney or pyonephrosis with an acute exacerbation was considered. The family history was negative and had no bearing on the case. As a child he had measles and typhoid fever. He was temperate in his personal habits. Since early childhood he had always experienced dull pains in the left loin with

occasional and intermittent hæmaturias, which would confine him to bed for a few days at a time. These attacks became less frequent in early adult life. For 6 months before admission to the hospital, the symptoms recurred frequently enough for him to seek advice.

The cystoscopic report showed that the bladder was normal. The right ureter was catheterized without difficulty, and clear urine was obtained. The left ureteral catheter met an obstruction 5 centimeters from the reddened orifice and a viscid brown fluid coming at a more rapid rate was obtained. The kidney function from the right side was good but apparently no dye was secreted from the left side.

A blood culture was made and found to be negative. The hæmoglobin was 58 per cent; the red blood cell count, 3,210,000; the white cell count, 12,720. The differential count: polymorphonuclear leucocytes, 84 per cent; small lymphocytes, 15 per cent; and large mononuclear, 1 per cent. The blood chemistry showed no retention of nitrogenous material. The following figures were obtained: urea nitrogen 13.7 milligrams per 100 cubic centimeters of blood; uric acid 1.66; and creatinine 1.5. The urine analysis showed a trace of albumin but nothing else of importance.

The general physical examination showed no disease of any other organs.

Inasmuch as he showed no improvement under the usual palliative treatment, a nephrectomy was decided upon. On June 23, 1922, the usual left loin incision was made and an enormous dark brown lobulated kidney tumor was found. It was necessary to puncture two of the posterior cysts; about 400 cubic centimeters of viscid brown colloid material drained out. The lower pole of the tumor extended below the crest of the ilium and was delivered with great difficulty. The ureter was very much thickened. The entire thickened kidney pedicle was clamped with two heavy Kocher clamps and the kidney was removed. It was not considered safe to remove the clamps so they were left in place for 3 days. Toward the close of the operation, the patient went into shock. The pulse was very rapid and difficult to estimate. He was infused while on the operating table and the rectal sphincter was dilated. He rallied.

The patient made a rather uneventful recovery and was out of bed 19 days after the operation. He was discharged on July 21, 1922, in excellent general condition. The urinary secretion at this time was between 20 and 30 ounces of normal urine. An intramuscular injection of phthalein several weeks later showed a secretion of 75 per cent of the dye from the remaining kidney. The patient's condition has been followed up by correspondence. He reports normal health and attends to his usual occupation.

ARBORESCENT LIPOMATA OF TENDON SHEATHS

A Report of Two Cases

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IN the August, 1922, number of Surgery, Gynecology and Obstetrics, a case of arborescent lipomata of tendon sheaths was reported by A. Strauss, of Cleveland, Ohio; the description of this case was followed by a most interesting and exhaustive analysis of the 18 cases so far reported in the literature, the first case being that reported in 1885 by Pavloff. The present writer noted with interest the extreme rarity of this condition as evidenced by the small number of cases reported and by the fact that no surgeon had reported more than one case of his own observation.

During the last 3 years the writer has had the curious fortune to meet with two cases of arborescent lipomata of the tendon sheaths about the ankle joint; the first patient consulted him for swollen, painful, and deformed feet of 7 or 8 years' standing on October 13, 1920, while the second patient presented himself on January 10, 1922. The writer has been moved to publish an account of these by a study of Strauss' excellent and stimulating article.

The first patient, a man aged 38, a packer by trade, limped into the writer's consulting room with difficulty and in obvious pain. Pointing to his feet, he complained bitterly of pain and suffering disabling him to the extent of interfering with his power of earning a livelihood. The swelling and pain had been of gradual onset and development but both had been extreme for 2 or 3 years. He had consulted doctors but none had been able to give him relief. When this patient removed his boots and stockings, the writer saw such a pair of feet as presented a clinical picture entirely new and amazing to him. He recognized at a glance that this condition was for him something altogether new. The accompanying pictures unfortunately give but a poor idea of the appearance they presented.

The three most striking abnormalities that were to be made out on examination were:

1. Large bulging swellings following the course of the tendons lying behind the two malleoli and extending both on the inner and the outer side of the foot into the sole. These were soft and fluctuating, without giving crepitation on movable pressure or on active movement of the underlying tendons. A certain amount of fine lobulation was, however, to be made out; the edges of the swellings were ill defined from the surrounding parts. The skin was freely movable over the swellings.

2. Extreme distortion and displacement of the toes. The four outer toes were drawn up into a hyperextended, indeed, a subluxated position on the dorsum of the foot and clawed, leaving the metatarsal heads prominent and projecting on the sole of the foot. The hallux was, in addition to being hyperextended, drawn into a marked varus position on the metatarsal head. The deformity of the toes was fixed, incapable of correction by either active or passive force.

3. A marked degree of laxity of the ligaments of the ankle and tarsal joints associated with an extreme permanent eversion of the feet at these joints. Partly owing to this and partly to the swelling over the lower part of the tibialis posticus tendon on the inner side of the foot, both feet appeared excessively flat.

What constituted, however, the most surprising factor in the clinical appearance was the extraordinary symmetry of the two feet. In both, the position, size and shape of the swellings, the nature and degree of the distortion of the toes, and the degree of the flat foot were absolutely identical.

A diagnosis of tuberculous tenosynovitis was made and the patient admitted to hospital. X-ray examination showed nothing but a well-marked spur on the under surface of each os calcis. The Wassermann reaction on the blood was negative.

The true nature of the swellings only became obvious during the operation. The writer had operated on cases of arborescent lipomata of the knee joint and recognized the similarity of these swellings to this condition. Nevertheless the pathological findings at operation were sufficiently astonishing. Growing around and from and indistinguishable from the wall of the tendon sheaths was a mass of finely lobulated and vascular fatty tissue, the bulk of the swelling, however, consisting of shaggy villi loaded with fat projecting into the synovial cavity at all points from parietal and visceral layers of the sheaths alike. In places apparently some of these villi had become hæmorrhagic, being fibrous and in places blood stained; a few had apparently become detached from their pedicles and lay as loose bodies inside the sheath. Where the peroneus longus tendon sheath descended into the sole of the foot so that the masses of villous fat had been subjected to continual pressure, the fat was largely missing, the villi here being composed of

Fig. 1.

Fig. 2.

Fig. 1. Arborescent lipomata of tendon sheaths of tibialis posticus and peronei associated with extreme deformity of the toe. Note in this figure the swelling along the course of the tendon of the tibialis posticus, the hyperextension with subluxation of the four outer toes and the hyperextension with adduction of the great toe.

Fig. 2. Arborescent lipomata of tendon sheaths of tibialis posticus and peronei associated with extreme deformity of the toes. Note the swelling along the line of the peronei tendons.

fibrous tissue; the largest of these, of the size of a large marble and hard as cartilage, lay in the sheath attached to its parietal layer beneath the cuboid bone by a very thin and narrow pedicle. The condition found in all four positions in the two feet was practically identical.

A most striking phenomenon of the pathological picture, however, was the manner in which projecting villi of fatty tissue had grown through the interstices of the neighboring ligaments into the tarsal joints; not only so but where the sheaths became continuous with the periosteum of the backs of the malleoli, similar fatty villi were found that had grown through tiny holes through this periosteum and had actually eaten their way into tiny pits in the bone itself.

The masses were stripped from the tendons which were cleaned throughout their length. Further operations were found necessary, however, to correct the deformities and make the feet painless for walking. Thus on each side, by tenotomies and excision of the heads of the metatarsal bones, the displacement of the toes was corrected and the pressure of the weight of the body through the metatarsal heads relieved. The spurs on the heels were removed. An arthrodesis of the flail midtarsal and subastragaloid joints was performed to stabilize the foot and correct the valgus deformity.

There has been since no sign of recurrence of the lipomatous masses.

The second case, a policeman, aged 35, presented himself on January 10, 1922, complaining of pain and swelling on the inner side of the left ankle, of a duration of from 8 to 10 years. He had been examined by many doctors; he had complained of this trouble often while in the army throughout the duration of the War. Examination showed a diffuse, soft, elastic swelling without clearly defined edges and with a fine lobulation lying along the course of the left tibialis posticus tendon. Though of a much smaller size the swelling reminded the writer of those of the first case and he made a tentative diagnosis of lipoma of the tendon sheath. He advised its removal. During the operation all the changes seen in the first case were recognizable in a less developed state but the resemblance between and the identity of the two conditions were unmistakable. This patient was relieved of all his symptoms by the operation.

It seems to the writer impossible in the first case to be certain whether the deformity of the toes was an independent phenomenon or one connected in any way with the presence of the lipomata. There is no doubt, however, that the flail condition of the tarsal joints was largely the result of the weakening of their ligaments through stretching, and of penetration by lobules of the tumors.

HYDATID CYSTS OF THE SPLEEN, WITH REPORT OF FOUR CASES

By H. W. MILLS, M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.A.C.S., San Bernardino, California
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HYDATID cysts of the spleen are rare, comparatively so for the world in general, actually so in the case of America. Statistics vary very much, and as has been pointed out by Dévé are vitiated by the fact that enough care has not been taken to segregate primary and secondary cysts. Hector McKenzie has pointed out that Thomas' statistics for Australia are particularly weak, not only for the reason mentioned above, but also because they include many outside cases.

It is a curious fact, too, that the relative incidence of splenic cysts varies considerably in different parts of the world. Thus they are notably infrequent in Iceland and Australia (Warot), two of the most hydatid-infested countries in the world. Finsen gives the Iceland statistics as 0.78 per cent. As regards Australia a perusal of the voluminous literature on this subject bears out Warot's statement; and Wilson, of Adelaide, states that "in South Australia hydatid cysts of the spleen are comparatively rare."

In Braquehaye's recent statistics, 2.6 per cent were hydatid cysts of the spleen.

Without going deeper into this matter one may safely take Dévé's figure of 2.1 per cent as to all intents and purposes correct.

In the Argentine, Vegas' and Cranwell's estimates of 3.7 per cent must be accepted. Albo, of Uruguay, notes that in Montevideo Hospitals, from 1908 to 1912, out of 375 cases of hydatid cysts, there were three of the spleen. He quotes Pena to the effect that in the children's clinic, from 1896 to 1913, out of 150 cases operated upon (125 personal) there were two hydatid cysts of the spleen. This gives us a percentage of about 1 per cent for Uruguay. The combined South American statistics (Argentine and Uruguay) work out at 2.3 per cent, i.e., approximately the same as those of Dévé. Greenway's statistics for Argentina show 2.14 per cent for the spleen.

On the continent of Europe, Trinkler has pointed out that whereas hydatid cysts of the spleen are fairly common in France and Germany—most authors think more so in the latter country (Lainé, Warot, Martin)—Russia should be accorded the first place in this respect; for, though in his list of 70 cases 48 came from France and Germany and only 7 from Russia, yet the latter obtained in a period of 5 years, while the former went back to 1790. Fowler's combined statistics (1922) showed 191 reported cases up to 1894.

This relative world-infrequency of hydatid cysts of the spleen is not surprising when we reflect that the liver-filter stops 75 per cent of the hexacanth embryos and the lung-filter another 10 per cent, so that only 15 per cent are left to develop into cysts in other parts of the body. Moreover not every embryo survives; on the contrary most of them fall by the wayside, for man is not by any means a favorite secondary host of the tænia echinococcus.

The route of invasion is now conceded to be via the blood stream, though Gangolphe taught that the lymphatic one obtained. The latter is quite unproven, and the possibility thereof rests on two cases, one of Dévé's (primary hydatid cyst of a mediastinal lymph gland) and one of Dufau's, quoted by Roche, in which an hydatid cyst was found in the interior of an inguinal gland in a female in 1892, who also had an hydatid cyst of the liver. This was probably a case of contemporaneous primary development of cysts in the liver and in the inguinal gland. The latter cannot have been secondary to the former, as though hydatid sand might have gained access to the inferior vena cava by rupture, the elements contained—brood capsules and scolices—would have fetched up in the pulmonary capillaries. The latter will transmit the hexacanth embryo, but not the scolex, which is five or six times as large.

The somewhat fantastic theory has been championed by Cras, and passively accepted by subsequent authors, that the larvæ may migrate upstream by a sort of reflux into the spleen from the portal vein. Vegas and Cran-

well have pointed out that if this actually were so, one ought to find as many primary hydatid cysts in the spleen as in the liver.

Again, Chachereau has been at pains to suggest another weird route, and thinks that the embryos, with truly malignant ingenuity, bide their time, and instead of perforating the gut high up, wait until they have arrived at the rectum and can take advantage of the fact that they can thereby short-circuit the liver and lung filters and arrive at the heart via the hæmorrhoidal veins.

One is prepared to admit the hardiness of the parasite after reading Leidy's account of living brood capsules in a hydatid cyst the host of which—a dissecting room subject—had been pickled for months in zinc chloride: but the above mentioned conduct of the embryo strikes one as, to say the least, improbable.

Finally Mariau has observed, in the newly-born, small veins passing from the splenic flexure of the colon to the lower pole of the spleen—another back door for the irrepressible embryo! But why look for bizarre methods of attack when the simple one is so obvious? The hexacanth embryos with a loss of 85 per cent of their effective strength arrive, via the liver and lungs, at the left heart, whence the 15 per cent of survivors are distributed throughout the body. Seeing that, for mechanical reasons, the brain takes the first toll of these, and that both the kidneys and muscles and connective tissue take precedence over the spleen (Dévé), 2.1 per cent is a very fair share for the latter, which, quâ primary hydatid cysts, in order of frequency of organs involved, comes fifth in the adult and sixth in the child (Dévé).

HISTORICAL

All the earlier cases were regarded as post-mortem rarities. Berthelot appears to have reported the first case in 1790. In 1808 Lüderson added another. But the condition was almost unknown before 1821, when Morgagni published his (autopsy) case. This was followed by Barret's case, also a postmortem observation, in 1827. Other cases were recorded by Degaille in 1850, Voisin (autopsy record) in 1852, Davaine in 1860, and Magdelain in 1868. Besnier in 1875 brought the subject up to date, and Lefèvre's thesis appeared in the same year. In 1876 Brault published his case, in which "hydatidenterie" obtained; postmortem it was found that an enormous hydatid cyst of the spleen had ruptured into the transverse colon. Various theses rapidly followed—Le Noël, 1879; Lainé, 1888; Casanova and Trinkler, 1893; Cras, 1896; Roche and Vanvert, both in 1897; Baraduc, 1898.

In 1889 Quénu recorded a case successfully treated by the transpleural route, and Leprévost one which recovered after being twice tapped. Dieulafoy's two lectures at l'Hôtel Dieu were delivered in 1899, and remain to this day a classic on this subject. He reported two personal cases.

Apparently in Germany only five cases of hydatid cyst of the spleen had been reported up to 1889, of which three were by Madelung (1885).

Trinkler collected 70 cases, including his own, which recovered after operation in two stages. These were all the cases known up to 1891.

Cras' thesis was based on 14 cases, including two personal ones. The first patient recovered after incision and drainage. The second, who had a suppurating hydatid cyst of the spleen which perforated the diaphragm, died after a transthoracic drainage operation.

Roche's thesis was based on two previously unpublished cases of hydatid cyst of the spleen from Marseille. The first patient recovered after marsupialization of the cyst.

CLASSIFICATION

Since the appearance of Dieulafoy's masterly articles in 1898, his classification of hydatid cysts of the spleen into cortical, central and juxtasplenic, has been universally accepted by all subsequent authors (Scherb has added the abdominothoracic form). Likewise his types—ascending (immobile) and descending (mobile).

From a surgical point of view we may, with Segond and Potherat, divide hydatids of the spleen into three groups:

1. Those containing much fluid but few daughter cysts;
2. Those packed with vesicles;
3. Suppurating cysts.

Martin in 1908 described in detail the various anatomicopathological and clinical forms as follows:

a. The anterior cyst (gastrosplenic), frequent (vide Chaintre and Casanova);

b. The posterior cyst—pancreatic-splenic (vide Gallozi and Hahn);

c. The superior cyst, which often contracts adhesions with the left lobe of the liver and diaphragm (vide Chaintre);

d. The inferior cyst. Common. Adhesions with small intestine (vide Sokoloff, Brault, Lacas-Championière);

e. The parietal cyst. Secondary infection from trauma often occurs, and the contents may become purulent or bloody.

There is no general consensus of opinion as to the relative frequency of Dieulafoy's forms. Thus Davaine regards the cortical as the most usual one, and of course Bland-Sutton concurs, believing as he does that the subperitoneal connective tissue is the selective habitat of the parasite in man.

On the other hand Mortureux, Dieulafoy, Hanot and Hahn regard the hydatid cysts of the spleen as "usually a central tumor, with surrounding compensatory splenic hypertrophy."

Practically, however, it is not of great importance whether the cyst begins as a central one and is subsequently "externalized," or whether it originates superficially and subsequently penetrates into the substance of the spleen.

The juxtasplenic cysts are usually of secondary origin.

COURSE AND SYMPTOMS

The early development is insidious, and the evolution very slow. Symptomless abdominal enlargement is often the cause of the patient seeking medical aid. Thus Quénu's and Duval's patient considered herself pregnant. It is only where pressure on the surrounding organs occurs, owing to the increasing size of the cyst, that pain is complained of. The entire course may be symptomless (Kehlberg, Wilde).

Generally speaking the symptoms are abdominal in the descending type—dyspepsia, nausea, vomiting, vague intra-abdominal pains, a sense of heaviness in the abdomen, symptoms of intestinal obstruction (Sokoloff); and thoracic in the ascending type—dyspnœa (15 per cent in Trinkler's 70 cases), symptoms of pleuropneumonia (Durozier), etc. These symptoms are, of course, common to all cysts of the spleen (blood and lymph cysts as well as hydatid cysts).

Pain in some form, however, according to Dieulafoy, is usually one of the earliest symptoms. It may be so severe as to suggest tabetic crises (Chaintre). It may simulate intercostal neuralgia (Concetti). It may be absent from beginning to end (Bezançon). Other symptoms which have been noted are a change of character and neurasthenia (Cras), mild icterus (Bourdel), hæmaturia (Kuehn), local "crawling" sensations (Reboul), also the impossibility of lateral decubitus (Roche and others).

Frequently symptoms have appeared only after trauma, as in the cases of Ikawitz, Vivenza, Leprévost, Roche (postmortem).

The general condition of these patients is notoriously good, and may be a factor in arriving at a correct diagnosis.

Whatever the form of the tumor, the cyst itself is absolutely spherical (Dieulafoy), and compensatory hypertrophy of the spleen obtains analogous to that which Hanot, Hahn, and Pontick have described in the case of the liver, so that even after the removal of a large cyst, what is left of the splenic pulp often weighs much more than a normal spleen does. In Sneguirew's case the spleen was three times as large as normal.

Ultimately suppuration of the cyst with inflammatory adhesions to neighboring organs, and perforation of the diaphragm with the result of sudden death or perhaps evacuation via a bronchus, or into the stomach ("hydatidemèse"), intestine ("hydatidenterie" of Dévé), or abdominal cavity may occur. In case of traumatic rupture of a fertile, non-infected cyst, secondary abdominal insemination may be expected. Very rarely external rupture has been observed (Warot, Brault).

According to Litten (cit. Moynihan) calcification of the walls of splenic cysts is rather common. Vide also Gérin-Roze and Bougle.

Cases of spontaneous cure have been recorded (Bastian, Vegas and Cranwell, and one in Barts' Hospital reports, vol. viii, p. 180).

DIFFERENTIAL DIAGNOSIS

The differential diagnosis is from:

1. Non-parasitic cysts of the spleen (true and pseudo-cysts, vide Fowler and Powers), which themselves are only distinguished from other splenic tumors by the presence of fluctuation (Mosler cit. Trinkler). Solid tumors of the spleen—the various forms of splenomegaly, malaria, leukæmia, etc. (Picoud and Ramond): primary carcinoma or sarcoma of the spleen, of which 43 cases have been recorded to date according to Fowler (vide Gaucher, Debove, Wichselbaum, Jepson and Albert, Council, Jepson, Deaver, Bush, Friedrick, De Renzi, Solis-Cohen and Riesman, Goldstein). Primary tuberculosis of the spleen (Rendu and Widal, Lefas, Moutard-Martin, Guiliani). Dermoid cysts (Andral): two dermoid cysts, and 90 cases of genuine and false non-parasitic cysts of the spleen have been reported in the literature to date (Fowler).

2. Tumors of the kidney and floating kidney. Potain mistook a hydronephrosis for a splenic cyst, and Gérard-Marchant a renal cyst for a splenic one.

3. Pancreatic cysts, lymphatic cysts of the great omentum and retro-omental pseudocysts (Bolognesi, Pomiselli, Arzela).

4. Cysts of the pelvic connective tissue.

5. Ovarian cysts, dermoid and others (Cabannes).

6. Mesenteric cysts (vide Braquehaye, Tillaux and Tomiselli) of which the signs are excessive mobility, a sonorous sound between abdominal walls and tumor, and another above the pubes.

Hydatid fremitus is rare—more so according to Martin than in hydatids of the liver—and not pathognomonic (Cardarelli, Jones). It was noted in the cases of Jachard (cit. Mortureux), Magdelain, Trinkler, Tédenat, Martin, Zak. Maselli noted it in a distended urinary bladder.

The complement-fixation test, when the cyst is active, is positive in about 90 per cent of cases.

Casoni's Intradermal Test. Pontano regards Casoni's intradermal test as a very sensitive and reliable test in man.

It was positive in 84 per cent of his cases, against 66 per cent by the subcutaneous test, and 50 per cent by the complement-fixation test. In only 40 per cent of cases did he find that eosinophilia was increased. The presence of eosinophiles is confirmatory evidence only of hydatid disease (Sabrazes, Tuffier and Milian, Memmi, Darguin and Tribondeau), and may occur with splenomegaly in the absence of hydatid disease (McDonald and Shaw). To the long list of conditions in which it is found there must now be added—as Legue and Astraldi have recently shown—senile enlargement of the prostate.

Fernandez Ithurrat advises that four biological tests be made: the complement-fixation, the complement-fixation with unheated serum, determination of eosinophilia, intradermic reaction. He regards the intradermic as the most sensitive and rapid diagnostic method.

Pasquale del Torto regards the complement-fixation test as the most exact but advises that the intracutaneous reaction (the technique of which is easy) should also be employed.

TREATMENT

This is purely surgical, and the choice lies between:

1. Aspiration with or without the injection of parasiticides—mentioned only to condemn. (For death after puncture vide Chauffard, Gaillet, Rambeau, Harley.)

2. Marsupialization and drainage. Unsatisfactory, in that it is so often followed by chronic fistulæ and postoperative herniæ. Thus, of Casanova's eight cases, only one resulted in a satisfactory cure. It is, however, the operation of choice in suppurating cases where, as the result of dense adhesions, splenectomy is impracticable.

3. Exosplenopexy. It is conceivable that, under rare circumstances, this procedure may have a limited field of usefulness. But the description by its principal advocate, Villar, leaves one surgically cold. Jaboulay, who had used a similar technique for goiter, tried it on the spleen in 1893, but had to resort to

splenectomy because of hæmorrhage. In 1894 he tried it again. His patient died of phlegmon of the neck. There are six reported cases of this operation: Jaboulay, 1894; Houzel, 1897; Baudrimont, 1897; Quénu and Baudet, 1895; Villar, two cases, 1894 and 1895, his earlier case (leukopenic spleen) dying from hæmorrhage. Out of these six cases there were two complete cures—those of Houzel and Quénu and Baudet. (Vide also Bender and Hayden.)

4. Capitonnage of Delbet, who had one successful case. Impracticable in some cases, i.e., cysts in a high position or with calcified walls, and contra-indicated in suppuration.

5. Extirpation, i.e., amputation. Suitable for juxtasplenic cases only.

6. Splenectomy. Has been condemned as too radical by some of the older authorities (Chaintre, Besnier, Mortureux, Cras, Blum, Poulet, Roche). Also by Warot (usually), by Finkelstein, and by Vegas and Cranwell—the two latter very high authorities.

Martyn-Jordan has perhaps written the most eloquent plea for conservatism, and shows that a partial splenectomy (limited to the lower half of the spleen) is a safer operation in dogs than splenectomy. It is on the other hand accepted as the operation of choice, at any rate in the absence of infection or dense adhesions, by Hahn, Driaucourt (when cyst is intrasplenic and spleen mobile), Winckel, Vanverts, Jonnesco, Jordan, Février, Hartmann (when spleen is mobile), Dieulafoy, Casanova, and most recent authors, for only thus can we be sure that recurrence will not take place from an overlooked second cyst, and anticipate a rapid recovery. This tendency to the more radical operation is natural, for, as the result of the many successful cases of splenectomy for various conditions, e.g., hæmolytic jaundice in recent years, few will nowadays deny Dieulafoy's dictum that "splenectomy causes transitory blood changes only." Incidentally, congenital absence of the spleen is not a serious handicap (McLean and Craig).

It is only right to mention that some authors hold different opinions (Gachet and Pachon, Beau, Charrin, Pitts and Ballance, Lewerenz, Ascoli). In this connection one might mention the observations of Steubenrausch, who found splenic nodules scattered throughout the peritoneum of patients on whom splenectomy had been done a year or two previously, i.e., compensatory hypertrophy of accessory spleens.[1] Macht and Finesiluer have recently shown that in rats the muscular integration is improved, if anything, after splenectomy.

All Trinkler's splenectomy cases recovered except that of Koeberle, and here previous tapping was partly responsible for the result.

In 1867 Péan reported a successful splenectomy for cyst of the spleen, but according to Roche this was not an hydatid cyst, though Vanverts classes it as such.

Koeberlé's splenectomy for hydatid cyst was the first recorded case (1873). His patient died. Successful cases were shortly after reported by Credé, Thornton, Fehleisen, Wright (3 cases), and Mas, 1889 (the first successful Spanish case).

Among Cras' 14 cases of hydatids of the spleen (1896), one (obs. 11 Hahn) was treated by splenectomy and recovered.

Vanverts, the first great advocate of splenectomy for this condition, reported, in 1897, 18 cases with 15 recoveries, i.e., a mortality of 16.5 per cent, and states that the "suppression of the functions of the spleen causes no danger in man or animals; its functions are probably assumed by the lymphatic glands and the bone marrow."

Février (1901) adds three (Moulonquet, Carnabel, Slavcheff) to Vanverts' list; of these 21 cases 18 were cured—mortality 14.3 per cent.

In 1901 Leonté, of Roumania, reports 12 cases with 8 cures—an unusually high mortality.

In the same year Tédenat quotes Hahn's 7 cases with 5 cures; and Muscatello, whose mortality was 14.2 per cent—compare Trofinioff's mortality of 28 per cent for incision and drainage. One of his personal cases recovered after splenectomy, the other was treated by incision and drainage, and rupture into a bronchus occurred.

Villar in 1903 writes of splenectomy as the operation of choice, and, with Jonnesco, ad-

[1] Cit. J. F. Connors. Ann. Surg., 1922, lxxvi, 786. Vide, also, H. Eggers.

vises the surgeon to stand on the right side of the patient during the early stages of the operation.

Jordan, 1903, reports a successful case of his own and abstracts 17 from literature with 15 cures, a mortality of 11.8 per cent.

Warot (1905) gives the mortality as 11.1 per cent in 45 cases (Vanverts 18, Villar 2, Dieulafoy 1, Driaucourt 3, Jordan 17, Hartmann 1, personal 2, Poncet and Delore 1), but as in this list the cases of Mas, Hahn, Sneguirew, Richelot and Hartmann are reduplicated, appearing as they do in the previous lists of both Vanverts and Jordan, Warot's list should read "40 cases with 5 deaths," i.e., a mortality of 11.5 per cent.

Granowsky, in 1905, reported one case of splenectomy for hydatid cyst of the spleen with recovery.

In 1906 von Schmarda reports a successful case, and mentions 26 splenectomies from literature in addition to another (unpublished) case similar to his own.

In 1908 Johnston, of Richmond, Virginia, cited 8 successful cases reported between 1900 and 1908 (Carnabel, Delore, Slavchev, Tricomi, Latarjet, Jordan, Giannettasio, von Herczel). Of these I have been unable to locate the last, and the first five are included in Warot. He gives the mortality, up to 1908, as 17.8 per cent.

Martin in 1908 reports three splenectomies for hydatid cysts of the spleen with two deaths.

In 1911 Biondi reported a successful case, and Froelich another in 1913. Fowler in the same year quotes Bergman's case as the second successful one of splenectomy for hydatid cysts of the spleen, and states that up to 1890 there were 58 records of solitary hydatid cysts of the spleen reported, and that other organs were affected in 42 of them. He gives the mortality of splenectomy as 17 per cent. The same author, writing in 1922, gives the mortality in 48 splenectomies for hydatid cyst (Finkelstein 46, Sherren 1, Hitzrot 1) as 15 per cent.

Finkelstein (Russia), 1914, reports two personal cases of splenectomy for hydatid cysts.

Sherren reported a successful case in 1914.

Edelman of New York performed a successful splenectomy for hydatid cyst in 1921.

Mei, from his experience among the Bedouin tribes in North Africa, prefers marsupialization.

The case, reported in 1922 by Lubbers and Noordenbos, of splenectomy for hydatid cyst of the spleen, died.

Thus we have 56 cases: Moulonguet 1, Warot 40, Granowsky 1, von Schmarda 1, Johnston 3, Martin 3, Biondi 1, Froelich 1, Sherren 1, Finkelstein 2, Lubbers and Noordenbos 1, Edelman 1; of these 8 died, a mortality of 14.3 per cent.

This mortality is reasonable, and by careful selection of cases could be still further reduced, probably to the figure suggested by Mayo in 1913 for splenectomies in general, i.e., 5 to 10 per cent.

Partsch has pointed out that most fatalities after splenectomy are due to hæmorrhage as a result of adhesions, and that only the induction of pneumoperitoneum can give a clear conception of the extent of such adhesions.

It is only right to add that, while investigating the subject on the occasion of the recent visit to South America under the auspices of the Clinical Congress of the American College of Surgeons, I found that the majority of the leading surgeons in Argentina and Uruguay—and they are all experts in the matter of echinococcosis—were by no means wedded to splenectomy as a routine treatment for hydatid cysts of the spleen. On the contrary, they reserve this procedure for cases of multiple cysts of the spleen, or those in which the spleen was practically destroyed by one enormous clean cyst. Smaller clean cysts they preferred to treat by the closed method (Lagos Garcia reported, in 1908, five cases in children so treated), and suppurating cysts by marsupialization.

The use of Finochietto's aspirator is still regarded as *sub judice*. In two cases (both hydatid cysts of the liver) in which I saw it used, a considerable amount of fluid escaped around this enormous trocar as it was plunged in. Extreme care had been taken to pack off the field, but some contamination of the lips of the wound may undoubtedly occur in such cases.

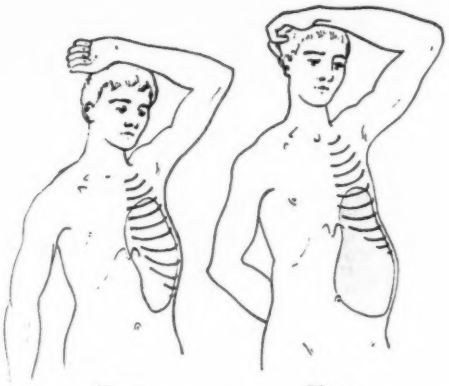

Fig. 1. Fig. 2.

Fig. 1. Hydatid cyst of spleen; ascending type. (After Dieulafoy. Les kystes hydatiques de la rate. Paris 1898–99.)

Fig. 2. Hydatid cyst of spleen; descending type. (After Dieulafoy.)

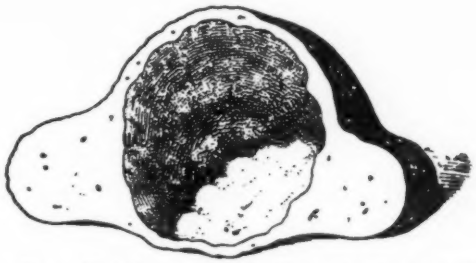

Fig. 3. Hydatid cyst of spleen, illustrating the spherical form of the hydatid cyst, and the compensatory hypertrophy at poles of the spleen. (After Dieulafoy.)

HYDATID CYSTS OF THE SPLEEN IN AMERICA

Lyon's list of 241 cases of hydatid cysts up to July 1, 1901, incorporating the previous ones of Osler and Sommer, included 9 of the spleen, i.e., 3.7 per cent.

Up to the present date, out of some 200 subsequent cases of echinococcosis which I have collected from North American literature, there have been only three reported cases of hydatid cyst of the spleen—one by Cahana in 1917, one by Jones in 1920, and one by Edelman in 1921. To these I now add four previously unpublished cases.

Case 1. Courtesy of Dr. H. H. Sherk, of Pasadena, California, 1907. Danish female, age 22, nurse, 4 years in America. Diagnosis: ovarian cyst. At first operation, three large omental cysts, the size of a cocoanut and full of daughter cysts were removed; at second operation, a mass consisting of three large splenic cysts, the size of fetal head. Marked hydatid intoxication. Marsupialization, prolonged suppuration, ultimate complete cure. Diagnosis verified by Dr. Stanley P. Black, of Los Angeles.

Case 2 (courtesy of Dr. M. Isnardi of San Francisco). Basque shepherd, age 30, 6 years in America, was operated on in 1913 for hydatid cyst of the spleen. This case was again operated on by Dr. Rixford, in the temporary absence of Dr. Isnardi, for a recurrence in 1916; on this occasion the cyst, full of daughter cysts, had ruptured into the abdominal cavity. Marsupialization. Recovery. Eosinophilia 17 per cent.

Case 3. 1917. Postmortem case in the practice of Dr. Stanley P. Black, the late well-known pathologist of Los Angeles. Because of Dr. Black's untimely death I have been unable to secure details of this case beyond the fact that it came from Southern California, that the patient was a foreigner, and that hooklets were demonstrated.

Case 4. 1921. Private communication from Dr. W. A. Downs of New York. Italian man just arrived in America. Solitary echinococcus cyst of the spleen. Operation. Recovery.

Thus 16 cases of hydatid cyst of the spleen are all that have been reported in the entire literature of North America to date, so I think that my statement at the beginning of this paper, that hydatid cysts of the spleen are *actually* rare in America, is justified.

ABSTRACT OF CASE REPORTS

I append here brief abstracts of 50 cases of hydatid cysts of the spleen. The first 17 are historical, and are here included because they are constantly quoted, often without chapter and verse, and are not particularly easy of access. The rest are of comparatively recent date, i.e., since 1900.

Case 1. 1850. Degaille. Male, age 22; diagnosis "cold abscess." Opened by caustic potash. Death 12 days later from infection. An example of the old method of treatment.

Case 2. 1868. Skoda. Male, age 46. Severe pain necessitated the frequent injection of morphine. Puncture. Hooklets demonstrated. Severe hydatid reaction. Two subsequent punctures with injection of iodine. Recovery. A happy result from treatment which is now obsolete.

Case 3. 1870. Durozier. Spleen one vast hydatid cavern; cyst had opened into bronchus (compare cases of Deboue, Lafargue, and Malassez and Martin).

Case 4. 1876. Brault. Male, age 57. Severe intractable diarrhœa and death. Postmortem, enor-

mous hydatid cyst of spleen, full of degenerated daughter cysts, opening into transverse colon. Adherent to liver. An example of "hydatidenterie."

CASE 5. 1883. Blum (Mortureux obs. 1). Enormous hydatid cyst of spleen. Symptoms of intestinal obstruction. Full of daughter cysts. Marsupialization. Two months later fistula persisted. This man lived and slept with cats and dogs.

CASE 6. 1884. Bourdel. Boy, age 11. Three years mild icterus. Spleen reduced to a shell, pulp practically absent and replaced by two hydatid cysts. Mesenteric and prevertebral lymphatic glands enormous. Here the excessive development of the abdominal lymphatic ganglia apparently supplemented the splenic functions.

CASE 7. 1888–1889. Dieulafoy. Male, age 42. Spleen free from adhesions and low in abdomen. Enormous hydatid cyst of spleen pushing up the diaphragm. Cyst adherent to spleen only at hilum. Marsupialization. Recovery. This case was juxtasplenic and consequently the spleen was respected. An example of the ascending type.

CASE 8. 1888–1889. Dieulafoy. Upper limit of dullness at fifth rib instead of third, as in Case 7. Enormous cyst of spleen in a male whose general condition was good. Splenectomy. Cure. An example of the descending type.

CASE 9. 1888–1889. Case of Arnozan, cit. Dieulafoy. Illustrates the compensatory hypertrophy which obtains in the splenic pulp in such cases. (Compare cases reported by Robert, Jayle, and Sneguirew.)

CASE 10. 1889. Lainé. Man, age 61. Part of cyst herniated through abdominal wall, skin red over prominence. Incised, clear fluid and daughter cysts escaped. The tumor, the size of a fetal head, reached down to the iliac fossa. Incision and drainage. Two communicating apartments in cyst. This cyst would shortly have burst externally.

CASE 11. 1892. Hope Grant, female, at age of 18, had a large splenic tumor. At the age of 20 "two chambersful" of watery fluid came away and the tumor almost disappeared. Ten years later four cysts were passed per rectum; still small splenic tumor. An example of "hydatidentrie."

CASE 12. 1892. Maclaren. Enormous hydatid cyst of spleen. Tapped. Cyst contained 12 pints of fluid in which scolices were demonstrated. Five weeks later operated in two stages. No bleeding. Membranes removed and cyst drained. Depth for a long time more than 12 inches. Sinus remained 2 months later. No anæsthetic at second stage of operation, as incision of spleen or liver is painless. Also no danger of dissemination.

CASE 13. 1893. James Oliver. Female from New Zealand. Cyst adherent to anterior abdominal wall from pubes to 2 inches above umbilicus, and attached by a pedicle to lower border of spleen. The shape of a Florence Flask. Contained many daughter cysts. A juxtasplenic cyst.

CASE 14. 1894. Trinkler. Female, age 46. General debility and night sweats. Children 13, miscarriages 3. Splenic tumor extended 13.5 centimeters below the ribs. Mental derangement 6 months. Tumor mobile like those of omentum. Hydatid fremitus. Operated upon in two stages. No succinic acid or sugar. Many daughter cysts. Drainage. Infection. Urticaria. Three months later fistula persisted. Illustrates the disadvantage of marsupialization.

CASE 15. 1895. Casanova. Female, age 37. Splenic tumor 4 years. Cyst adherent to omentum and full of daughter cysts. Cyst sprung from left border of spleen. Incision, resection of part of sac and marsupialization of rest. Discharge caused intense skin irritation. Fistula 2 years and 4 months afterward. Illustrates the poor results of marsupialization.

CASE 16. Sneguirew (Moscow). 1895. A juxtasplenic cyst. Splenic artery wounded during enucleation, and, after a jet of steam had failed to stop hæmorrhage, splenectomy had to be resorted to.

CASE 17. 1897. Roche. Tumor appeared in region of spleen after a violent fall in 1889. Symptoms of rupture appeared but soon cleared up. They recurred in 1896. Dyspnœa. Rupture. Hooklets demonstrated. Severe reaction and urticaria. Marsupialization, and cyst packed with gauze. Urticaria and suppuration followed with discharge of daughter cysts. Recovery. Illustrates the influence of a *locus minoris resistentiæ*, which has been mentioned by Verneuil, Danlos, Kirmisson, Magdelain, Leprévost and Vivenza.

CASES OF HYDATID CYST OF THE SPLEEN THAT HAVE BEEN REPORTED SINCE 1900

CASE 18. Tédenat (Montpellier). 1901. Shepherd, age 33. Splenic tumor size of two fists. Spleen weighed 1825 grams and contained 20 hydatid cysts Some adhesions. Splenectomy. Recovery.

CASE 19. F. Villar, 1903. Patient had been operated on in 1900 for hydatid cyst of liver. Now has multiple abdominal cysts, two in spleen and one in pancreas. Operation: excision of 12 hydatid cysts of mesentery and omentum. Through separate paracostal incision spleen was exposed, adherent to diaphragm. Section of splenic vessels and subtotal splenectomy, small shell adherent to diaphragm left. Marsupialization of small remnant of splenic cyst. Pancreas, capitonnage of Delbet. Discharged cured a month later.

CASE 20. F. R. Seagar, 1903. Boy, age 11. Mass in region of spleen 4 months, larger after meals and at night. Complained of "stitch." Operation: two-thirds of anterior surface of spleen occupied by a shining yellowish tumor. One pint of clear fluid drawn off. Thick cyst wall shelled out. No daughter cysts were found. Marsupialization was done. Recovery.

CASE 21. Delore and Poncet. 1903. Female, age 25. Hydatid cysts of spleen, pelvis, and omentum. Splenectomy. Recovery. Spleen weighed 1100 grams. Hooklets demonstrated.

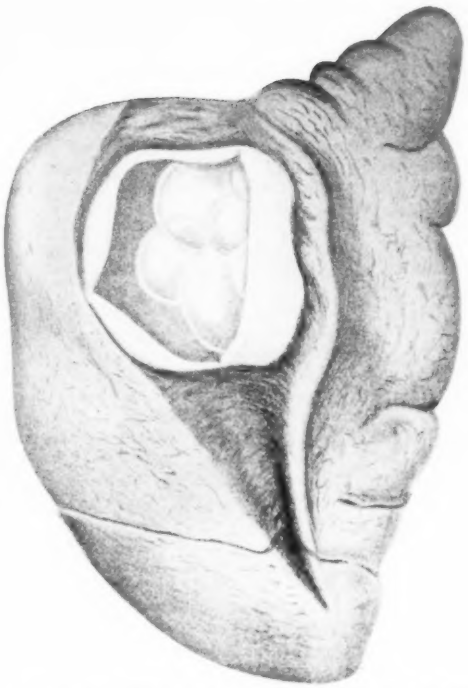

Fig. 4. Hydatid cyst of the spleen, showing daughter cysts *in situ*. (From *Hydatid Disease* by James Graham[1].)

Fig. 5. Hydatid cyst in hilum of spleen (Museum of St. Barthelomew's Hospital). (Taken from *Tumors Innocent and Malignant* by Sir John Bland-Sutton[2].)

CASE 22. S. Ceraulo. 1904. Solitary hydatid cyst of spleen in a female from Palermo, age 29. Three months pregnant. Tapped. Recovery.

CASE 23. Ceraulo. Boy, age 13, who recovered from an hydatid cyst of the spleen that had been tapped.

CASE 24. Scherb (Algeria). 1904. Indigenous male with enormous tumor in left flank which had been diagnosed as a malarial spleen. Practically no symptoms except compulsatory left decubitus. Eosinophilia 6 per cent. Slight fever indicating infection. Scherb diagnosed hydatid cyst of the spleen of ascending type. Operation: incision and lips sewed to wound, 12 litres of fluid evacuated: resection of tenth rib and suture of diaphragm to thoracic wall. Through-and-through drainage. Recovery.

CASE 25. N. Giannettasio. 1905. Primary echinococcus cyst of a malarial spleen in a female, age 38. Splenectomy. Spleen weighed 850 grams and contained 6 litres of pus. Recovery.

CASE 26. L. Granowsky. 1905. Female, age 14. Pain and swelling under left costal arch 6 months. Urticaria. Tumor size of baby's head. No daughter cysts. Splenectomy. Recovery. Typical lamination of cyst wall. Postoperative increase of leucocytes from 8,000 to 20,000 and of red blood cells by 500,000; proportion normal again on tenth day. Granowsky likens the hydatid urticaria to that produced by the injection of animal serum. Advises splenectomy, and notes that the blood changes thereafter are temporary only.

CASE 27. Maurice Warot (Algeria). 1905. Female, age 42. Hydatid cyst in ectopic spleen. Operation: incision, removal of membranes and suture without drainage. Most of spleen destroyed. He prefers simple incision and suture without capitonnage, thinks that marsupialization should be reserved for suppurating cysts, and advises splenectomy only where spleen is destroyed by cyst, free from adhesions, and with clean contents.

CASE 28. T. G. Wilson (Australia). 1905. Female, age 39. Pain in left side since a few weeks before last confinement (twins). Abdominal swelling which appeared to spring from pelvis. Fluid thrill. Diagnosis, ovarian cyst. Operation: hydatid cyst of spleen which had become adherent to pelvic brim and burst during operation. A second (subcostal) incision made and 4 pints of clear fluid evacuated and membranes removed. Redundant capsule cut away and remnants sewed to parietal incision which was closed in layers. Small drainage tube for 24 hours. Discharged cured in 3 weeks.

[1]Reproduced by permission of the publishers, Young J. Pentland, Edinburgh and London.

[2]Reproduced (together with Fig. 6) by permission of the publishers, Messrs. Cassell & Co., Ltd., London.

Fig. 6. Solitary hydatid cyst of the spleen, containing degenerated vesicles and membrane. From a woman aged 54 who died from bronchitis. No symptoms during life to draw attention to the spleen. Specimen in the Museum of St. Barthelomew's Hospital. (After Bland-Sutton.)

Notes chronicity of sinuses after marsupialization, and regards the above method, advocated 20 years earlier by Thornton, as the best one for clean cases.

Case 29. S. von Schmarda. 1906. Butcher, age 37. Hydatid cyst size of man's head in spleen, and one size of fist in left lobe of liver. Splenectomy. Recovery.

Case 30. C. Symington. 1907. Reports an hydatid cyst of the spleen the size of a billiard ball, in a native suffering from tuberculosis.

Case 31. A. Martin. 1908. Female, age 23. Fairly movable tumor in region of spleen, omental cyst suggested. Operation disclosed pedunculated hydatid cyst attached to the spleen.

Case 32. A. Martin. Male, age 36. Increased eosinophilia. Hydatid fremitus. Operation: four hydatid cysts of spleen and five of omentum. Splenectomy. Death from shock same night. Postmortem, hydatid cyst found in thoracic cavity.

Case 33. A. Martin (courtesy of Raymond). Feather-maker, age 48. Hydatid cyst of spleen. Splenectomy, diaphragm torn in detaching spleen which was completely destroyed, pneumothorax, death. Illustrated danger of splenectomy in presence of dense adhesions.

Case 34. A. Martin (courtesy of Pauchet). Man, age 38. Tumor size of adult's head, diagnosed as hydatid tumor. Eosinophiles increased. Operation: hydatid cyst of spleen enucleated. Two years later splenectomy. Recovery.

Case 35. A. Martin (courtesy of Lucas-Championiére). Male, 35, from colonies. Symptoms of tuberculosis. Hard abdominal tumor. Operation: Hydatid cyst of spleen full of daughter cysts. Marsupialization, as patient very anæmic. Recovery.

Case 36. A. Martin (courtesy of Jonnesco). Man, age 52. Puncture, hooklets found. Operation: cystic tumor adherent to spleen. Marsupialization. Recovery.

Case 37. Case reported by the Australian correspondent of the *Lancet*, 1909. A middle-aged man got into a fight and died next day. Postmortem, a ruptured hydatid cyst of the spleen was found. Spleen reduced to a mere shell. No symptoms during life.

Case 38. J. B. Cristopherson. 1909. Nubian female from Egypt, age 30. Operation: hydatid cyst of spleen, broad ligaments, omentum, and mesentery. Daughter cysts and hooklets. Contracted disease in Egypt.

Case 39. D. Biondi. 1911. Country female, age 42. Tumor noticed in left hypochondrium after childbirth, but no symptoms for 7 years; then high fever and epigastric pain developed. Pronounced eosinophilia. Operation: non-suppurating multilocular hydatid cysts in spleen, which was adherent to diaphragm, colon, and the walls of the vena cava. Splenectomy. Recovery.

Case 40. Pieri and Poucel. 1913. Female, age 35. Diagnosis, hydatid cyst of kidney. Complement-fixation test positive. Operation: hydatid cyst in inferior pole of spleen. Resection and spleen sutured. Recovery. Advocates marsupialization in two stages.

Cases 41–42–43. B. K. Finkelstein (Caucasus). 1914. Reports three cases of echinococcus cysts of spleen, all males. Two recovered and one died (shock). Two splenectomies and one splenotomy. Sixty-six personal splenic operations from 1903 to 1913. In 1909 reported 46 splenectomies with 8 deaths. He thinks splenectomy should be done only when cysts are enormous, when there is extensive destruction of the spleen, and when the spleen is displaced and the pedicle twisted.

Case 44. James Sherren. 1914. Female, age 25. Symptoms of tubercular peritonitis with urticaria in 1909. Splenic tumor 1904. Eosinophiles 1.5 per cent. Operation: large white unilocular cyst on gastric surface of lower pole of spleen. Adhesions to liver, abdominal wall and diaphragm. All other abdominal organs normal. Splenectomy. Recovery. Spleen weighed 3 pounds, 4 ounces, and contained 100 cubic centimeters of clear fluid in which scolices and hooklets were demonstrated. The ascites, diarrhœa, and urticaria in 1909 suggest rupture of the cyst.

Case 45. A. Cardarelli. 1919. Female, age 41. Tumor coming from under left costal margin, ad-

herent around umbilicus, moves with respiration. Temperature normal; no icterus. Complement-fixation test negative. Slight eosinophilia. Patient well except for pain. Aspiration of 800 cubic centimeters of limpid fluid containing some albumin. Notes that hydatid fluid is free from albumin except near or after death of parasite—the cyst lives on albumin. Quotes Calabrese's case which was aspirated monthly for a year with resulting cure. Advises aspiration with subsequent incision if cyst suppurates. Quotes cases proving that hydatid fremitus is non-pathognomonic quâ hydatid cysts.

CASE 46. Zwirn. 1921. Female, age 55. Splenic tumor 7 years, now fills left half of abdomen. Very little pain. Operation: Sprengel incision. Enormous hydatid cyst of the spleen containing 4 litres of fluid and many daughter cysts. Lavage with ether, and tight closure. Attached to abdominal wall. Wound healed in 10 days. Advocates total immediate closure. Two months before operation this patient had evacuated, by vomica, clear salty fluid, and subsequently pus.

CASE 47. Boinet. 1921. Female, age 60. Born in Sicily but had lived long in Marseille. Postmortem, a large hydatid cyst of the spleen was found projecting from the inner surface of the spleen occupying its entire thickness, adherent to kidney and diaphragm. Fluid clear. About 15 daughter cysts, the size of grape seeds. Notes the resemblance here to the "kyste emerjeant" of Mabit.

CASE 48. E. Zak. 1922. Female, age 29. Primary splenic cyst with multiple echinococcosis of abdomen and lungs. Anaphylactic symptoms after two miscarriages. Embryos demonstrated in blood stream. Hydatid thrill.

CASE 49. Lubbers and Noordenbos (Holland). 1922. Male, age 26. Splenomegaly ascribed to malaria. Splenectomy. Hydatid cyst of spleen of ascending type, hardly any splenic tissue left; death in 24 hours. Notes that prognosis after splenectomy is more favorable in the descending type of Dieulafoy. Also that the disease is rare in Holland.

CASE 50. Taddei. 1922. Patient had a large hydatid cyst in pelvis, one peritoneal cyst and one in the spleen. Operation: capitonnage. Avoided marsupialization as exposing to secondary infection and postoperative hernia. Advises that no drainage tube ever be used, that the formolage of Deve be adopted in splenic as in liver cysts, and thinks that partial resection of the sac and partial capitonnage are advantageous.

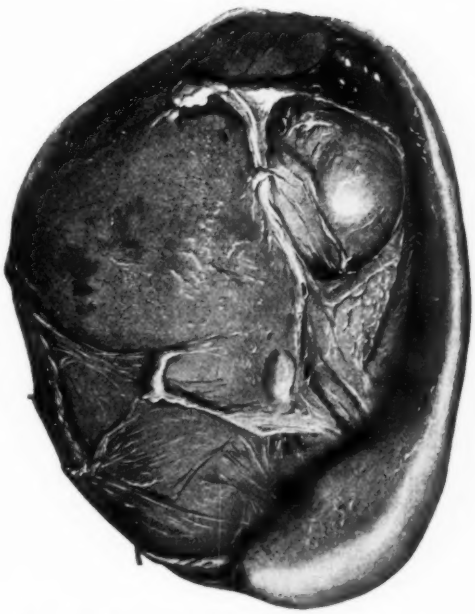

Fig. 7. Hydatid cyst of the spleen.
The patient was a woman, age 25, on whom a successful splenectomy was performed. The specimen is now in the Museum of the Royal College of Surgeons, London. (After Sherren[1].)

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[1]From an article by James Sherren, Brit. J. Surg., 1914, Oct. Reproduced by permission of Messrs. Wm. Wood & Co. of New York.

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PLEURISY OF THE HILUM REGION

Report of a Case[1]

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PLEURISY or encysted empyema of the hilum region is comparatively rare and but few cases have been reported. Consequently it is not well known and this is the reason for reporting this interesting case.

Barjon[1] classifies pleurisy as follows:

1. Pleurisy of the large cavity which may be (a) partial or total dry pleurisy; or (b) pleurisy with effusion.

2. Circumscribed pleurisy (encysted) which may be (a) interlobar, (b) diaphragmatic, (c) mediastinal, or (d) hilar.

While pleurisy of the hilum region is uncommon, there is little doubt but that it occurs much more frequently than we imagine.

Barjon[2] states, "Anatomically the region of the hilus is one of the most complex parts of the pleura. In the hilum is a sort of open space, found at the junction of the secondary diverticula of the pleura. The large pleural cavity, the interlobes, the anterior and posterior spaces of the mediastinal pleura all end in the neighborhood of the hilum. The diaphragmatic pleura alone does not show direct connection with the open space.

"This region of the hilum undergoes many changes. The hilum itself, the extremities of the pulmonary lobes, circumscribe a whole series of pleural folds, forming small grooves or small potential spaces, which adhesions may easily cut off. The adjoining organs, in particular the aorta, the artery, pulmonary veins, and vena cava, by the compression they exercise locally on these pleural layers may facilitate the formation of rapid adhesions on an inflamed pleura. It is easy to understand therefore that in this region small pleural diverticula may be isolated and become the seat of limited partial effusions.

"Causes of infection are not wanting in this region—the proximity of the large bronchi which bring it into direct communication with the outer air; the presence of numerous tracheo-bronchial, bronchial, and hilum glands which are there for the express purpose of serving as a barrier to infections, but which may, in their turn, transmit them; finally, the œsophagus which, through its proximity, may become the point of departure of disease as in the case observed by Cade and Goyet.

"All these reasons explain the possibility of pleural localizations limited to the hilum region. Radioscopy and clinical methods unite in demonstrating their existence."

Report of Case

The case reported was referred by Dr. C. A. Wells, of Quincy, for roentgenological examination on September 21, 1922, with a clinical diagnosis of possible pulmonary gangrene, and presented the following history:

Mr. F. L., age 42; white; occupation, piano salesman. Father and mother living and well; one brother and sister living and well; no familial taints nor any history of tuberculosis. The patient's general health had always been good and aside from the milder diseases of children and a mild attack of influenza in February, 1920, he had had no illnesses. He had always been under weight which never varied from 140 to 150 pounds. His habits were good although he moderately indulged in malted drinks in the pre-prohibition days. Venereal diseases were denied.

Present illness. On August 26, 1922, while on an automobile trip he was suddenly taken ill with chilly sensations but no distinct rigor. He continued his driving to a nearby town where he remained for 2 days, returning home by train. He complained of a chilly sensation, headache, and sensation of marked coldness over his right chest posteriorally. The temperature was 100 degrees F. On August 29, his physician was called. At that time he was considerably prostrated, the temperature being 102 degrees, pulse 100, respiration 24. The abdomen was somewhat distended, with slight pain in the right hypochondrium. The patient complained of a hacking, non-productive cough and a sense of coldness in his back, covering an area of 7 by 16 centimeters from the fourth rib downward on the right side. Over this area a pleural friction rub was thought to be detected.

[2] Barjon, F. Radiodiagnosis of Pleuro-Pulmonary Affections, pp. 13 and 50.

[1] Read at the annual meeting, Illinois Section, American College of Surgeons, Quincy, Illinois, December 1-2, 1922.

Fig. 1. Pleurisy of the right hilum region, examination made 18 days after spontaneous rupture of the abscess. September 21, 1922.

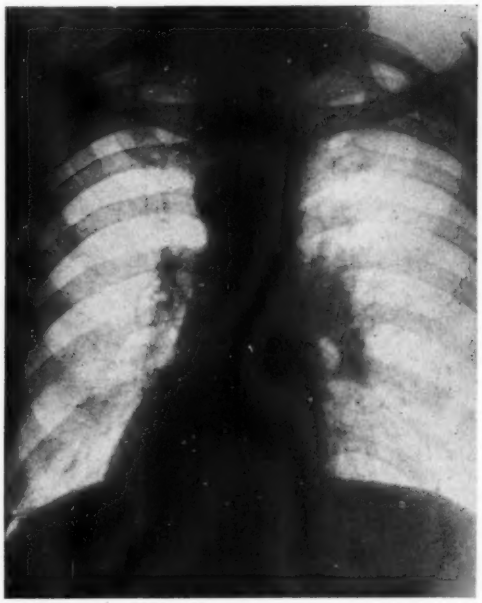

Fig. 2. Same case as figure 1. Note decrease in size of right hilum opacity. Patient much improved although still expectorating. March 7, 1923.

The above symptoms and conditions continued with some increase in the non-productive cough and slight increase in temperature until the afternoon of September 2, when, after a slight chill, his fever went to 104 degrees. About 1:00 a. m. the next morning, after a very prolonged coughing spell, he felt something give away in his chest and he coughed up about 2 ounces of a brownish, fœtid fluid. For the next few days more of this fluid was coughed up and the odor appeared more pronounced, the fluid becoming thicker and more grayish. The temperature dropped to 100 degrees where it would remain so long as the fœtid fluid was coughed up. When it could not be expectorated, the fever would rise after a slight chill.

The patient was kept confined to his bed for 2 weeks in positions favoring drainage. After this time he was allowed up. A sputum test was made for tuberculosis and was negative. The Wassermann reaction was also negative. On September 21, he had his first X-ray examination, the report of which was as follows:

"*Stereoscopic and fluoroscopic examination of chest.* Left lung: negative. Right lung: there is an irregular shaped opacity situated in the right hilum region which cannot be separated from the hilum itself but is not sharply defined; the lung itself does not light up as well as the opposite side although the parenchyma appears negative; there is some lagging of the right diaphragm. The cardiac shadow is not displaced and is within normal limits. Conclusion: This is one of those comparatively rare cases of pleurisy of the hilum region in the hilum open space of the pleura. They frequently rupture and empty into the bronchi causing a sudden appearance of purulent expectoration with extreme fœtid breath."

Following the X-ray examination the patient continued to improve generally. Aside from an occasional fleck of blood in the sputum there was no frank bleeding until the evening of October 6, when, after an unusual hard coughing spell, he suffered a violent hæmorrhage losing about 300 cubic centimeters of blood. From this date to November 13 there occurred 12 separate and more or less severe hæmorrhages, the largest being about 600 cubic centimeters in amount.

On November 23 another X-ray examination was made and the right hilus shadow appeared smaller, the patient showing considerable clinical improvement in the interval, although he was still expectorating.

The treatment in this case was limited to the symptomatic and medicinal.

Encysted empyema may develop in either hilum region, and may be localized in front of or behind the hilum. It is due to an infection, the origin of which is usually either bronchial, glandular, or œsophageal. If sufficiently firm

Fig. 3. Same case as figures 1 and 2. Note still further decrease in size and density of right hilum shadow, also the calcification present. Patient entirely well. June 28, 1923.

adhesions have had time to develop early, the empyema may remain localized in the hilum, develop there and, without progressing, undergo resolution, being evacuated spontaneously through the bronchi and rapidly cured. At other times it remains localized at first in the hilum and then affects the interlobe secondarily, becoming transformed into an interlobar pleurisy, and still later may affect the entire pleural cavity. Therefore, hilum pleurisy may precede any form of pleurisy, whether total, interlobar, or mediastinal. The true hilum phase is usually short and gives only slight local symptoms and may easily pass unnoticed. Roentgen examination alone detects these localizations, being shown by an opacity, the appearance of which depends on whether the examination is made before or after the evacuation into the bronchi. Before evacuation, a very distinct opaque shadow with well marked outline is seen. After evacuation, the contour is less distinct, being sufficient, however, to attract attention to the hilum.

In the case reported, if an examination had been made before evacuation, we would probably have seen the interlobar phase, the opacity being much larger and more sharply defined. Since the examination was made 18 days after the first evacuation, the opacity was comparatively small and not so opaque or sharply defined. The unusual symptom of this case was the marked recurring pulmonary hæmorrhages some weeks after the primary rupture of the abscess.

CONCLUSION

Pleurisy of the hilum region can be successfully diagnosed only by a combination of a careful history with a roentgenological study. Without a careful history the increased hilum shadow might be interpreted as a mediastinal tumor, glandular masses, or limited pulmonary lesions. Because of the extreme fœtid odor such cases may simulate pulmonary gangrene. However, in pulmonary gangrene, the fœtid odor precedes the expectoration, stethoscopic signs are more important, and the general condition is more serious.

NOTE.—After this paper was read, another X-ray examination was made on March 7, 1923, and although the right hilum was still more prominent and denser than normal it was distinctly smaller than at the previous examination. In the interval, the patient had been attending his business, enjoying fair health, but continued to expectorate daily.

The last heard from him was on June 28, 1923, when he reported that about March 15 he had had three pulmonary hæmorrhages, each of several tablespoonsful, making him very weak. He had continued daily expectorations but in gradually decreasing amounts until about 6 weeks ago when they ceased. Since then he has felt fine, having fully regained his weight and strength. Another X-ray examination was made at this time and the right hilum shadow showed a marked decrease in size and density, being practically normal in outline, although still somewhat larger than on the opposite side. The hilum shadow appeared entirely due to fibrous tissue and much calcification. The patient also reported that several months ago, when expectorating considerably, he consulted a physician in another city where he had moved. This physician pronounced him tuberculous and advised him to go to a sanitarium. A sputum examination was made but proved negative for tubercle bacilli. The subsequent X-ray examination and history of the case, however, showed no evidence of pulmonary tuberculosis.

LESIONS OF THE URETER WITH SPECIAL REFERENCE TO OBSTRUCTION AND INFECTION

A Factor in the Development of Certain Forms of Nephropathology[1]

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THE general idea of ureteral lesions until recently has been extremely vague, and in those instances where some idea of ureteral pathology did exist, not much importance has been attached thereto. Of late, however, this previous attitude of indifference has given way to an increasing tendency to regard the status of ureteral drainage as the key to the solution of a large percentage of nephropathic problems.

In this discussion, I wish to include only the common types of obstruction and ureteral infection. Ureteral stone, tuberculosis, and cancer I shall not include; they are each distinct and separate problems.

With this limitation in mind, I shall discuss the several phases of ureteral disease, and present brief case histories and roentgenographic illustrations which I consider representative of the common types of ureteral lesions, showing, in contrast, early and late involvement.

For the purpose of this discussion it is convenient to classify ureteral lesions as obstruction or infection, according to the predominating pathology.

URETERAL OBSTRUCTION

Under this classification I shall include all forms of ureteral narrowing, from the congenitally small ureter to the definite formation of connective tissue stricture. I have chosen to consider obstruction first as I am of the opinion that obstruction, as above defined, is the underlying cause of most, if not all, ureteral and renal infection.

It has long been a recognized fact that bladder stasis is the most frequent underlying cause of cystitis. It seems equally consistent that a known stasis in the upper urinary tract should produce similar problems.

Etiology and types of obstruction. From the standpoint of etiology, the obstruction is either congenital or acquired; while according to the factors in its development, it is either intrinsic or extrinsic.

In considering types of obstruction, one must keep in mind three main conditions. The ureter of abnormally small caliber, either in whole or considerable part, in which no definite band or constriction is present; the definitely strictured or constricted ureter, in which a definite band or limited area of narrowing exists; and the ureteral kink.

Ureters of small caliber. Of the etiology in this group there can be no question, it is congenital.

In defining this group it is difficult to say just what should be considered the normal caliber of a ureter, but it should be able to conduct the urine from the kidney to the bladder without allowing development of renal stasis.

There is no doubt that in many instances ureters of very small caliber are able to accomplish this under normal conditions, but when something occurs to produce congestion and swelling of the ureteral mucosa, ureteral colic and renal pain supervene. As a usual thing, these symptoms promptly disappear, in the early stages, after the passage of a bougie or a catheter (Case 1, Fig. 1).

Ureters of this type are prone to become involved in infectious processes, with attendant anatomical changes (Case 2, Fig. 1).

Stricture. In defining stricture, I believe that all narrowing involving a definite, limited area, should be included; particularly, narrowing sufficient to produce stasis. Most strictures are encountered at one of three points in the following order of frequency: ureterovesical junction, ureteropelvic junction, and the iliac crossing.

There is one other point at which stricture has been more recently recognized, and that is at the broad ligament in the female and at the vaso-ureteral crossing in the male.

Etiology. In 1910 Bottomley (1) published a report of 56 cases which he concluded com-

[1] Read by invitation before the Jackson County Medical Society, May 15, 1923.

a. *b.*

Fig. 1. *a.* Case 1. Abnormally narrow ureters. Easily obstructed. Arrows mark ends of ureteral catheters. No evidence of infection. Tracings indicate outline of upper ureters.

b. Case 2. Dilatation entire ureter, infective process. Ureteritis of several years' standing.

prised the cases of ureteral stricture appearing in the literature up to and including his publication. These cases ranged in age from fetal life to 50 years, and analysis was either by autopsy findings or by operation. He concluded from analysis of the cases, including the cases upon which he had personally operated, that the condition was congenital. Bottomley's report was significant in that his opinion was based on examination of specimens removed at operation or autopsy.

The most recent contribution to this phase of the subject is by Brown (2), of Detroit, in a comprehensive postmortem study of the urinary tract of 80 unselected cases in fetuses and young infants. Of these 20 per cent showed malformations of the upper urinary tract involving the kidney; hydronephrosis, etc., and 11.25 per cent involving the ureters. In conclusion he stated that in his opinion "the kidney manufactures urine months before maturity of the fetus, and probably in con-

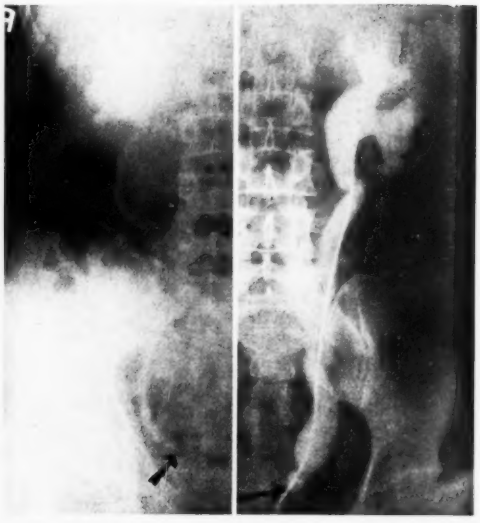


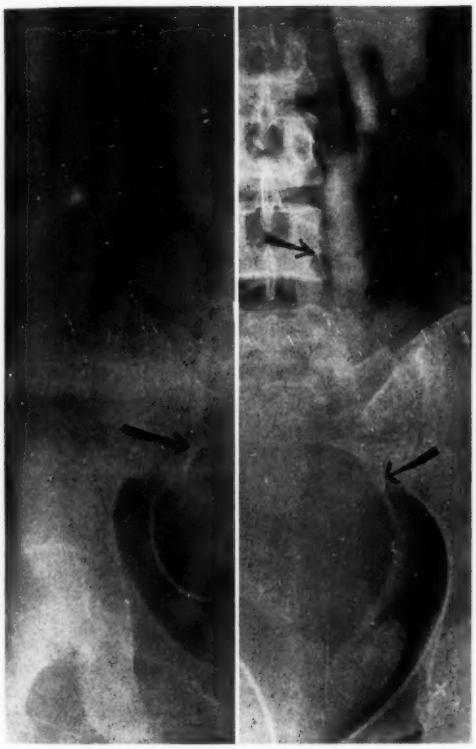
Fig. 2 (left). Case 3. Stricture of the ureter, vesical juncture. General dilatation above. No evidence of infection.

Case 4. Stricture of the ureter, vesical portion. Infection of several years' standing. Marked dilatation.

siderable quantity. Also the fetus may develop a toxæmia from retention in its blood stream of kidney products independent of the blood stream or kidney efficiency of the mother."

If we keep in mind the complicated fetal development of the genito-urinary tract, with the evolutionary opening of the ureter into the bladder after its origin from the Wolffian duct; and the formation of the renal pelvis from the dilated upper end of the ureteral canal by contraction at the point of branching, it is not difficult to understand that any derangement in the evolutionary development of these structures may cause ureteral malformation. In the studies previously referred to, in several instances the ureter had altogether failed of opening into the bladder and in others the openings were of hair-like caliber.

In contrast with the methods of study of earlier observers, whose opinions were based upon operative evidence, our conclusions today are largely a result of clinical observation in conjunction with cystoscopic procedure. While our ability to deal with these cases by cystoscopic methods has deprived us



a. *b.*

Fig. 3. *a.* Case 5. Stricture of the ureter. Iliac crossing. No evidence of infection.
b. Case 6. Stricture of the ureter. Iliac crossing. Infection of several years' standing. Note the marked dilatation of ureter above the obstruction.

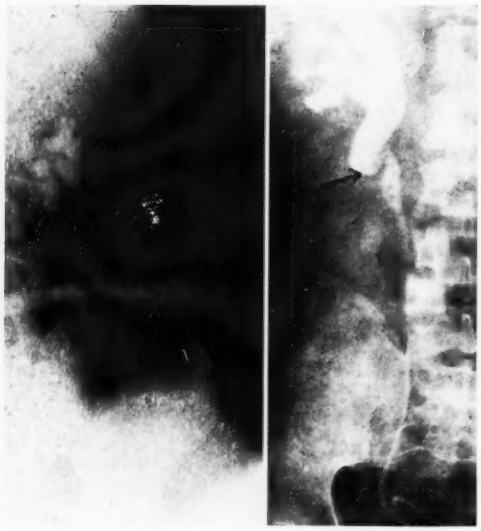
a. *b.*

Fig. 4. *a.* Case 7. Stricture of the ureter. Ureteropelvic juncture. No evidence of infection. Small dilatation.
b. Case 8. Stricture of the ureter. Ureteropelvic juncture. Considerable dilatation with infection. Several years' standing. Also constriction of ureter, region of the broad ligament.

of the opportunity of cutting down on many of these lesions, still, as modern urological methods are becoming better known, we are enabled to see these cases early and note the changes which occur, whereas the earlier observers saw only the end-results.

Hunner (3) is of the opinion that stricture is the result of focal infection. With this main contention I am in accord; but I believe that congenital malformation with disturbed ureteral function and stasis is the primary factor which defines the site of metastatic involvement which may well result in the formation of connective tissue and further narrowing. In this connection, the point which I wish to emphasize is that although in many instances infection appears to be the immediate problem, yet, from a therapeutic standpoint, we must keep in mind the congenital aspect and establish free ureteral drainage.

Finally, although the etiology must be in doubt in many cases when seen in the later stages, wherein infection and extensive pathological conditions obtain, still I am of the opinion that if these cases could be seen early, congenital ureteral pathology could be demonstrated in most instances. Cases 3 and 5, Figures 2 and 3, are representative of congenital stricture situated at the ureterovesical junction and at the iliac crossing, without infection. Cases 4 and 6, Figures 2 and 3, show the changes which occur with infection. Cases 7 and 8, Figure 4, likewise are representative of the early and late appearance of the renal pelvis with stricture of the ureter at the ureteropelvic junction.



a. *b.*

Fig. 5. *a.* Case 9. Kink, upper third of ureter. No evidence of infection.
Case 10. Kink, upper third of ureter. Infection with extensive anatomical change.

Stricture from extrinsic causes. Stricture due to extrinsic causes is confined almost entirely to the lower ureter. The proximity of the lower ureter to the tip of the seminal vesicle, and the extreme frequency with which the vesicle is involved in inflammatory processes, provides a situation in which the ureter might well become frequently involved in this process. The importance and relative frequency of this lesion has been pointed out by Mark (4), Herbst (5), and others.

A somewhat analogous situation frequently obtains in the female in the region of the broad ligament.

Ureteral kinks. The ureteral kink, I believe, is primarily a congenital affair, probably another phase of mal-development—a vestige of the sausage-like fetal ureter. Such kinks occur almost exclusively in the mid or upper portion, and, according to personal observation, are usually associated with stricture. The sagging of the kidney seen in many of these cases is undoubtedly secondary to enlargement as a result of the ureteral stricture. These kinks usually are discovered during the course of a urological examination made to determine the cause of ureteral colic or renal pain, and I am of the opinion that the stricture is the pain producing lesion rather than the kink, excepting perhaps in those cases in which the kink has become fixed through inflammatory reaction. Cases 9 and 10, Figure 5, are representative of early and late phases of ureteral kink.

a. *b.*

Fig. 6. *a.* Case 11. Ureteritis involving the lower portion of the ureter. Characterized by extreme dysuria.
b. Case 12. Ureteritis involving greater part of the ureter. More marked in the midportion. No dysuria.

Diagnosis of obstruction. I cannot too strongly emphasize the importance of knowing the condition of the ureter in dealing with lesions in the upper urinary tract. The notably poor results obtained by indiscriminate renal fixation for hydronephrosis are mostly due to the application of treatment to the result rather than to the cause of the condition. I recall one such case in which I had occasion to dilate the ureter, with complete and immediate relief of pain after fixation had failed to influence the symptoms (Case 8, Fig. 4).

In dealing with infections in the upper urinary tract, it is of the greatest importance to know to what extent ureteral obstruction is responsible for the conditions which foster the development of infection. How illogical it seems to wash out a renal pelvis through a small ureteral catheter and depart leaving untouched the ureteral obstruction, which is often the real factor!

Again, in so-called "essential" renal hæmaturia, what urologist has not seen these cases in which he could discover no definite cause for the bleeding, but in which it subsided after ureteral catheterization?

It is therefore not alone sufficient to know that we are dealing with an enlarged renal pelvis, or renal infection, or renal bleeding. We should know to what extent faulty ureteral function is primarily responsible and correct this, if we would really solve the problem. In treating the average case of pyelitis, if a choice had to be made between a No. 5 catheter with pelvic lavage, or a No. 10 bougie, without lavage, I should choose the latter.

There are two methods of demonstrating ureteral obstruction, by the bulb catheter or bougie, and by ureterography. A combination of both is desirable in order to obtain all possible information. When used in combination we are able to know whether there is obstruction by the hang of the bulb and the ureterograph gives us an idea as to the type of obstruction and whether or not anatomical changes have occurred.

URETERAL INFECTION OR URETERITIS

While ureteral stricture has been a fairly well recognized pathological entity for a considerable number of years, ureteritis is still almost unknown, or is regarded with extreme indifference except by a limited few. Even textbooks on urology, with few exceptions, either omit the subject altogether, or dismiss it more or less as a curiosity. It is a well known fact, however, to those who have had the opportunity of making a careful study of the ureter, that ureteritis is one of the common causes of abdominal or pelvic pain and dysuria, especially in women. Some of my most extreme cases of dysuria have been due to inflammation of the lower ureter.

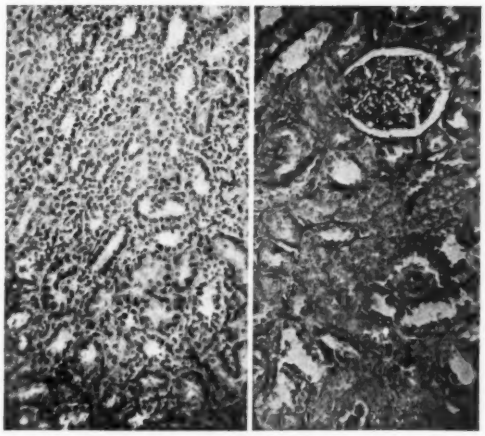


Fig. 7. Case 13. Section through the cortical and medullary portion of kidney 4 days after release of a complete ureteral block of 8 days' duration. There are no pathological changes with the exception of occasional areas of cloudy swelling involving the descending loops.

Infection is the immediate cause, and is either a lymphatic extension—the condition is frequently associated with chronic infections of the urethra—or is metastatic from distant foci. Although infection is the immediate cause of ureteritis, I am of the opinion that obstruction and stasis are remote factors. At any rate, from a therapeutic standpoint these cases respond to dilatation of the ureter below the lesion. In this connection, it may be objected that certain cases of ureteral infection present the picture of a wide, open-mouthed ureter with general dilatation. Some of these cases are undoubtedly due to congenital absence of the ureterovesical valve allowing regurgitation of the bladder urine, which again brings us back to the question of stasis.

In the majority of instances ureteritis occurs in the lower ureter and is usually associated with a high degree of pain and dysuria, due no doubt to the action of those muscle fibers of the trigone which extend upward along the ureter, in tugging on this anchorage during the muscular contraction of the trigone in drawing open the bladder outlet (Case 11, Fig. 6). Ureteritis occurring in the mid-ureter, however, is not uncommon. In these cases, pain and tenderness along the course of the ureter is usually the outstanding symptom. In other

cases the entire ureter is involved, exhibiting symptoms of both pain and dysuria. From an anatomical standpoint, the infected ureter eventually becomes thin, loses elasticity, and the whole becomes dilated and elongated. It resembles somewhat a piece of old flaccid rubber tubing. Case 12, Figure 6, and Case 2, Figure 1, are typical of ureteritis occurring in the above mentioned localities.

EFFECTS OF OBSTRUCTION AND INFECTION

Study of the effects of ureteral obstruction affords perhaps the most interesting phase of urology.

It must occur to anyone who attempts an analysis of the predominating tendency of renal infection to occur unilaterally, that some defining factor must be operative in preparing a soil more favorable for this development, on the one side rather than on the other; and according to the generally accepted idea this factor is urinary stasis. The most outstanding example of this is the well known right sided occurrence of renal infection in pregnancy.

Immediate effects and symptoms. The immediate effect of obstruction is urinary stasis. This stasis is transient or persistent, according to the character of the obstruction. In this connection can be seen a definite reason for the circular muscle reinforcement between portions of the ureter, at the ureteropelvic juncture and between the major and minor calyces; a provision confining the stasis to the immediate segment above obstruction and thus protecting the excreting structures of the kidney from back pressure till the last possible moment. The immediate symptom of obstruction is pain. As soon as stasis develops, involving either the ureter or kidney pelvis (which as previously stated should really be considered a part of the ureter), a stimulation of muscular contraction occurs in an effort to get the accumulated urine to pass outward. But not all phases of obstruction exhibit this symptom. It is known that pain, associated with obstruction, is due to muscular spasm, and that pain does not occur in marked dilatation after muscular tonicity is lost.

This symptom is present, therefore, in the earlier stages of obstruction, and is either of the acute, intermittent, colic-like type, or the persistent, aching type, according to whether the development of the obstruction is acute, or insidious. It is interesting to speculate regarding the pain period in some of the cases of large dilatation in which the patient recalls no experience of pain.

Possibly the development has been so insidious in nature that little attention was given the pain, or it may have been ascribed to digestive disturbance. Going further back and referring to the study of Brown, in which he concludes that the urinary function is operative in fetal life, perhaps these dilatations passed through the pain period at that time or in early life when abdominal pain is usually interpreted as intestinal colic.

Remote effects. The remote effects are both anatomical and functional. Their relationship is so closely interwoven that a combined consideration of the physiopathology seems most practical.

If the obstruction is intermittent and relatively transient, no anatomical change takes place and consequently there is no permanent damage. From a clinical standpoint, it is difficult to estimate the duration of obstruction necessary to produce anatomical changes. It has been shown, however, experimentally, that to accomplish this, rather persistent obstruction is required. Infection, in all probability, occurs more readily, in proportion, in those cases of acute or intermittent obstruction associated with acute hyperæmia, in which the mucosa is thrown suddenly into a high state of congestion, and likewise subsides more acutely with the passing of the obstruction. Those cases of pyelitis which clear up after one or two ureteral catheterizations and lavage are examples. The passage of the catheter establishes sufficient drainage to remove the cause of the congestion, and the infection is then readily controlled.

Results of obstruction on the kidney. This is the all important phase of the whole proposition. Studies of unusual import, both experimental and clinical, have recently been reported. With acute obstruction, there is an acute decrease in renal function, ranging in degree to complete cessation with complete obstruction. With the release of the obstruction, if within certain time limits, not only does func-

tion return, but a temporary supernormal function occurs, such as is seen in some cases of hydronephrosis in which the patient passes enormous quantities of urine during the first hour after release of the obstruction; an amount entirely out of keeping with the capacity of the renal pelvis, as has been demonstrated in these cases. Acute obstructions, then, which are not sufficiently permanent to produce anatomical changes, do not cause permanent loss of renal function. Even complete obstruction if of only a few days' duration does not result in permanent damage. From clinical observation, I am of the opinion that the disastrous end-results, pyelonephrosis, etc., which we see with ureteral obstruction, are more often seen with the partial, persistent type.

From experimental studies Hinman (6) has reported some interesting findings. He was able to release a complete ureteral block of 14 days or less, and with nephrectomy of the opposite side, get complete repair in the kidney of the blocked side. Crabtree (7) has reported clinical bilateral block of 4½ days' duration without apparent damage. Personally I have seen a prompt return of normal function following the release of an unilateral block of 8 days' duration (Case 13, Fig. 7).

When obstruction is of sufficient duration to cause anatomical changes, the situation is far different. Hinman's (6) experiments show that when damage once occurs, the damaged kidney, if left to its own devices, undergoes a gradual persistent atrophy, and that hypertrophy and compensatory function gradually develops on the opposite side. But if the opposite side is then subjected to embarrassment by partial, persistent obstruction of the ureter, repair takes place in the damaged side, and if the embarrassment is continued, atrophy occurs on that side while the previously damaged side continues to complete repair. This phenomenon he calls "renal counterbalance." This experimental evidence appears to coincide with the clinical observations of Crabtree (7) who, in a study of ureteral obstruction with hydronephroses which occurred during pregnancy, observed that the capacity of some of these renal pelves which stood at 200 or 300 cubic centimeters at that time, promptly decreased to about 15 cubic centimeters, or approximately normal, following the termination of the pregnancy. But subsequent observation disclosed the fact that these pelves soon underwent progressive dilatation, and that the process in some cases ultimately terminated in pyonephrosis.

It would appear from the foregoing evidence that, when once permanent damage has occurred, the tendency is for the healthy kidney to do more and more work and the diseased kidney to accomplish less and less, progressing toward permanent atrophy and total loss of function. And the experiments of Hinman tend to show that the outlook for repair is dependent upon shifting more work to the diseased side by creating a less favorable outlet on the opposite side. So far as I am able to learn, this plan has not been applied directly to clinical cases. However, the plan of maintaining supernormal ureteral drainage on the diseased side may accomplish similar results. This plan I have followed in several cases, and while the clinical picture is satisfactory, sufficient time has not yet elapsed to allow conclusion as to the final outcome.

CASE REPORTS

CASE 1. March 14, 1923, G. V., female, age 44, complained of pain of sudden onset, sharp, lancinating in character, beginning in the left loin and extending downward along the course of the ureter. There was hæmaturia, but no dysuria.

Urological findings. No evidence of obstruction could be demonstrated in either ureter, except a general small caliber of both ureters. The urine was free from pus or other evidence of infection. Catheterization of the ureters reproduced the previous symptoms. The left ureter was dilated to No. 7 F. on two occasions. There was no recurrence of symptoms on that side. One year later the patient had a similar attack of pain on the opposite side, which responded to similar treatment.

The outstanding feature in this case was the typical ureteral colic with no demonstrable obstruction of the ureter except the general small caliber.

CASE 2. June 24, 1920, C. K., male, age 39, complained of intermittent attacks of dysuria and hæmaturia, which began about 1 year previously. There had been slight persistent frequency.

Urological findings. The ureteropyelogram on the right disclosed a generally dilated and tortuous ureter. The urine contained pus and red blood cells. The symptoms gradually subsided with instillations of 2 per cent silver nitrate into this ureter at 5 to 10 day intervals. This was a general dilated condition of the ureter, undoubtedly due to infection.

CASE 3. September 6, 1921, L. M., male, age 30, complained of pain beginning in the upper lumbar region, extending downward and forward along the ureter. This pain began insidiously, but soon became colic-like. There was frequency and hæmaturia. He had hæmaturia on one occasion 8 months previously, but no other symptoms.

Urological findings. Bladder urine negative, except a few red blood cells. Catheterization of the right ureter was difficult, owing to constriction at the ureterovesical outlet. The urine was negative except for a few red blood cells. There was a definite hang of the bulb at the ureterovesical and pelvic junctures. The ureteropyelogram disclosed a hydroureter and pelvis, with constriction at the ureterovesical and pelvic junctures. The ureter was dilated to No. 11 F. at 10 to 20 day intervals during a period of about 6 months. There has been no recurrence of symptoms. The patient has gained 15 pounds in weight, which is in excess of any previous weight. This was undoubtedly a congenital stricture which had become involved in an acute œdema.

CASE 4. June 10, 1922, A. M., male, age 24, complained of frequency and dysuria of several years' duration, with pain in the upper left lumbar region, extending downward along the course of the ureter.

Urological findings. The urine was loaded with pus and colon bacilli. The left ureteropyelogram disclosed a mammoth ureter and double renal pelvis with stricture at the ureterovesical juncture. This was probably a congenital affair which had become involved in infection.

CASE 5. April 14, 1922, G. D., male, age 35, complained of colic-like pain of abrupt onset, situated in the lower right abdominal quadrant. There was nausea and vomiting. There was no urinary disturbance, nor any abnormalities in the urine. Appendicitis was suspected, but owing to tenderness in the costovertebral angle, his surgeon suspected a urinary lesion.

Urological findings. There was a distinct hang of the bulb at the right iliac crossing. The ureteropyelogram disclosed a definite stricture at this point with mild dilatation of the ureter above. This ureter was dilated on three occasions to No. 10 F. There has been no recurrence of symptoms. The patient has gained 18 pounds in weight, which is in excess of any previous weight. A diagnosis was made of congenital stricture of the right ureter at the iliac crossing. This is the type of patient who is often operated upon for appendicitis, unless the case is carefully examined from all angles.

CASE 6. September 12, 1922, F. M., female, age 34, complained of intermittent attacks of pain situated in the right lower abdominal quadrant and upper lumbar region. This patient had just passed through a recent and very stormy pregnancy, during which she had frequent exacerbations of temperature and chills associated with a great deal of frequency and dysuria.

Urological findings. The bladder urine was loaded with pus and colon bacilli. The ureteral pyelogram disclosed an enormously dilated ureter and pelvis above a constriction at the right iliac crossing. This proved to be a stricture of the right ureter at the right iliac crossing with large dilatation above, which had become infected during pregnancy.

CASE 7. March 29, 1923, N. S., female, age 26, complained of pain, dull, aching in character, situated in the upper right abdominal quadrant and lumbar region, which began about 4 years previously, and had been almost constant since. There had never been any frequency nor dysuria.

Urological findings. The bladder urine was normal. The ureteropyelogram disclosed a slightly dilated right renal pelvis of the drooping type of 14 cubic centimeters capacity. The obstruction was at the ureteropelvic junction, and was probably a congenital affair which had recently become symptomatic due to further development of the obstruction.

CASE 8. June 21, 1921, M. J., Female, age 45, complained of intermittent attacks of colic-like pain, situated in the upper right abdominal quadrant and lumbar region, extending downward along the course of the ureter, with frequent and painful urination of several years' standing. A renal fixation had been done, but the symptoms continued.

Urological findings. The bulb bougie hung at the broad ligament, and at the ureteropelvic juncture, on the right. The capacity of the renal pelvis was 60 cubic centimeters. (She had just recovered from an attack following which she had passed 1500 cubic centimeters of urine within the first hour.) The urine contained pus and colon bacilli. The ureteropyelogram disclosed strictures at the broad ligament and at the ureteropelvic juncture with large dilatation of the renal pelvis. Dilatation of the ureter afforded immediate relief. The outstanding feature of this case is the relief of symptoms following ureteral dilatation, after fixation had failed to influence the symptoms.

CASE 9. May 4, 1922, S. H., female, age 27, complained of intermittent colic-like pain in the upper right abdominal quadrant, and had been operated upon for appendicitis on this account 6 months previously.

Urological findings. The urine was normal. The ureteropyelogram on the right disclosed a kinked ureter in the upper third. The outstanding feature of this case is the probable error in diagnosis of appendicitis.

CASE 10. September 6, 1922, H. S., male, age 40, complained of persistent dull pain in the upper left abdominal quadrant which began with colic-like exacerbations several years previously.

Urological findings. The ureteropyelogram disclosed a kink in the upper third of the left ureter with large dilatation of the renal pelvis above. The urine was loaded with pus and colon bacilli.

CASE 11. January 25, 1922, N. B., female, age 20, complained of intermittent attacks of colic-like pain situated in the mid-left abdominal region, with blood in the urine, but no dysuria. These attacks began about 2 years ago. There had been persistent soreness in this region between the attacks.

Urological findings. The bladder urine was normal, except for a large amount of epithelium. The left ureter was catheterized with difficulty, because of the extreme tightness at the vesical outlet. The ureteropyelogram disclosed a ureter uniformly dilated and kinked in the upper third. The urine was negative except for a large amount of epithelium. The diagnosis was ureteritis involving most of the ureter, probably the result of a previous infection. Dilatation and instillation of 2 per cent silver nitrate effected a gradual but slow recovery.

CASE 12. August 4, 1921, N. C., female, age 54, complained of colic-like pain in the lower left abdominal quadrant, associated with extreme dysuria and much blood in the urine. There had been no previous attacks of pain, but during the past 10 years this patient had had slight dysuria.

Urological findings. Catheterization of the left ureter was difficult because of tightness at the vesical outlet. The urine contained pus and numerous red blood cells. The ureteropyelogram disclosed a dilated and elongated lower left ureter. Dilatation of the vesical outlet of this ureter with instillations of 2 per cent silver nitrate was followed by prompt relief of this patient's symptoms. There have been no recurrences. A diagnosis was made of ureteritis of probably several years' standing with an acute exacerbation probably precipitated by an acute œdema involving the obstruction at the vesical outlet.

CASE 13. April 24, 1923, C. O., female, age 22, was operated upon for the removal of a pelvic tumor. In the removal of the tumor the ureter was torn. The renal end was tied with catgut which 8 days later softened and urine from this kidney began to drain through the abdominal wound. The surgeon elected to do a nephrectomy. The kidney appeared normal except for moderate inflammation and thickening of the pelvis. A section of the tubules and glomeruli show only very slight changes (Fig. 7).

The reports are necessarily brief; they are presented to illustrate certain types of lesions and only the outstanding features are recorded which I believe are common to these cases. Stone, tuberculosis, etc., were eliminated in each instance. It will be noted that hæmaturia is a prominent symptom. Dysuria is almost a constant symptom with lesions of the lower ureter and in contrast is inconstant with lesions of the upper portion.

CONCLUSION

It is not my object to inject into the nephropathic situation the problem of ureteral obstruction, without a reason. I desire to call attention to the frequent occurrence and congenital aspect of ureteral lesions and to point out the regularity with which ureteral obstruction in some degree can be demonstrated in these cases of upper urinary tract disease, whether a hydronephrosis, a pyelitis, a pyelonephritis, or a pyelonephrosis. In many of these cases with immense dilatation and infection of the ureter and renal pelvis, seen primarily in the "end-result" stage, the early pathology remains in doubt. But if we keep in mind the fact that congenital obstruction is of frequent occurrence, that stasis and dilatation invariably follow unrelieved obstruction, that stasis is the prime factor in the development of infection, I believe that we may safely conclude that these factors are operative in the development of these conditions.

Finally, it is the early recognition and relief of these obstructions before extensive damage occurs that is the key to the situation, rather than treatment in the later stages in which it is evident that the probability of repair is meager.

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VENTRAL TUMORS OF THE SACRUM[1]

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TUMORS of the ventral sacrum comprise a group that develop in the hollow of the sacrum, have a definite capsule, are usually attached to the periosteum, and tend to erode the bone. Middeldorpf first associated them with the postanal gut; they are often spoken of as "Middeldorpf tumors." The tumors may appear to be somewhat rare, because of the fact that many persons affected die during birth, or in the first year of life, and the condition is not recognized. Births are usually normal; the tumors, as a rule, are about 8 centimeters in diameter; however, they may become very large and obstruct delivery. It is believed that females are more often affected than males.

Calbet, who collected a series of cases of sacral tumor in the newborn, found them to occur once in 34,582 births; in a series of 203 cases, 126 were found in the female and 60 in the male. In a series of 107 cases, 20 infants were born dead, 13 were premature, 7 went to full term, and 7 died during birth. These tumors do not, however, occur in children only; a considerable number have been reported in adults. The rarer types, such as dermoids and teratomata, are especially prone to develop in the sacrococcygeal region. In our experience the gliomata have been common. Giant-cell tumors, sarcomata, and carcinomata are not rare. Myomata occur occasionally, while fibromata, chondromata, osteomata, lipomata, and chordomata have been seen. Angiomata, epitheliomata, and endotheliomata have also been observed. The other most common types are dermoid cysts (pilonidal cysts and sinuses), mixed tumors, fetal inclusions, and abnormally persisting or hypertrophic caudal appendages, forming either a pseudo-tail (the result of hypertrophy of the caudal filament), or a true tail (the result of bony overgrowth or prolongation of the sacrum). Herrmann and Tourneux have made a careful study of sacral tumors, and confirm these findings.

The number of developmental errors arising in the evolution of the embryo accounts for the unusual number of tumors found in this region. It is in this area that the caudal termination of the primitive streak should, most accurately, attain its evolution and involution, the neurenteric canal develop and disappear, the anus complete the intestinal tube, the posterior fissure properly close, the coccyx and sacrum develop, and the inferior extremities symmetrically adapt themselves to the trunk. Moreover, within a few millimeters of the area under consideration the complicated evolution of the genito-urinary tract progresses.

EMBRYOLOGY

In a study of the tumors of the sacrococcygeal region, it is first necessary to review carefully the embryology of this portion of the spinal cord; its development varies considerably from the rest of the cord, as demonstrated by Keibel and Mall. At the beginning of the third month the neural tube still extends to the extreme end of the vertebral canal into the tail bud, and there is a close association between its slightly enlarged tip and the deep layers of the skin. Toward the end of the third month the spinal column, developing faster than the soft parts, draws along the part of the neural tube that is adherent to it, the extreme tip of which remains attached to the skin. Because of this unequal growth, the coccygeal portion of the neural tube is bent in the form of a loop, of which the deeply situated limb is attached to the posterior surface of the coccyx, while the superficial one assumes a more dorsal position. The deep limb atrophies and disappears during the fourth month; the superficial continues to develop. These structures have been called by Herrmann and Tourneux the "vestiges médullaires coccygiens." Later they atrophy, but traces of them may be recognized until the time of birth. Of the cells which line the

[1]Thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, March, 1923.

vestiges coccygiens, some flatten to become pavement cells, like the superficial cells of the ectoderm, while others lengthen and resemble the prismatic cells of the ependymal covering. Before extensive atrophy has taken place, the skin in this region becomes attached to the coccyx by the "caudal ligament" which invaginates and forms a depression, the walls of which are lined with a covering deprived of hair follicles and of sweat glands. The caudal end of the central canal extends through to the beginning of the filum terminale. At the lower end a conical expansion takes place, out of which irregular side pouches or blind elongated sacs develop. This caudal enlargement of the canal is designated as the "ventriculus terminalis."

For a time the tail anlage, spinal cord, chorda, and mesoderm develop at the same rate. As the tail bud is reduced, there is a reduction in the mesoderm, and the spinal cord temporarily becomes longer than the vertebral column. After the third month the process is reversed, and the vertebral column becomes longer than the cord. This unequal growth brings about a gradual change in the position of the cord in the vertebral canal, and results in the caudal end being drawn upward away from the lower end of the canal. During this process of shifting, the tip of the cord remains attached to the coccyx and becomes stretched out into the slender filum terminale. The nerve roots and their ganglia, with the exception of the coccygeal ganglion, already attached in the intervertebral foramina, are greatly stretched and are brought into an oblique position, the most caudal root being the largest and most oblique; thus the cauda equina is formed.

During embryonic life while the entoderm is forming the caudal intestine, the dorsal canal and dorsal cord, the mesoderm, the connective tissue, blood vessels, vertebræ and muscles, and the ectoderm is forming the primitive streak, the medullary tube and its vestiges, there is a continuation between the central canal of the spinal cord and the primitive alimentary canal around the caudal extremity of the notochord. This canal, which forms the communication between the cord and the gut, is known as the neurenteric canal.

When the proctodæum or primitive anus invaginates to form part of the cloacal chamber, it meets the gut some distance anterior to and above the point where the neurenteric canal opens into it; hence there is for a time a segment of intestine behind the anus termed the postanal gut. This, as well as the neurenteric canal, later becomes obliterated.

ORIGIN AND TYPES OF TUMORS

Sacrococcygeal tumors are composed of many varieties of tissue, and for that reason Rindfleisch has named them "histologic potpourri." Certain authors assert that the majority of these growths are primarily cystic, but a smaller number of solid tumors have also been reported.

Various types of structures may be found, as demonstrated by Nokayama, who carefully described thirteen cases of sacral tumors, reported by Chiari. Among the ectodermal structures were found fetal nerve tissue with recognizable ganglion cells, central canal and choroid plexus formations, epidermis and dermoid cysts. An optic vesicle was reported in one case. The structures of the entoderm consisted of rudimentary bronchial segments, often intestines, and in two cases each, pancreas, liver, and suprarenals. In the mesodermal structures there were observed fibrous connective tissue, mucosa, cartilage and bone, and often smooth and striated muscle. In one case two maxillæ with alveoli and lips, and one hand with phalanges, muscles, and nails were noted. The variety of tissues in these tumors naturally makes one curious about their origin. In some cases a certain type of tissue may predominate, making a diagnosis more simple. Rests of the fetal neural layers have been considered as a source of these tumors, because of the abundance of neuroglial tissue present. This may form the matrix for a proliferation of the other germinal layers and pave the way for further development.

The remains of the lower end of the neural canal, which closes irregularly, may give rise to gland-like structures lined with epithelium, such as Mallory found on examination of the tissues over the coccyx and sacrum six times in a series of seven cases, which he believed

had, in consequence of their origin, the possibilities of differentiating either into cells like the epidermis (as seen in dermoid cysts and sinuses in this region) or into ependymal cells and their derivatives, such as neuroglial tissue.

Broders has studied a considerable number of these tumors carefully, and feels that many of them are ependymal cell gliomata, closely related to carcinoma, since they develop from ependymal cells, which really are slightly modified epithelial cells. These tumors are soft and gelatinous, closely resembling myxomata or colloid carcinomata. On microscopic examination they closely resemble carcinoma of the breast, and some present areas imitating an alveolar arrangement similar to that of the ependymal cells in the cord. Practically all have cells with long tail-like processes, resembling the fibrils of fibroblasts.

Many of the cases in which ganglion cells or neuroglia were present were formerly called neuro-epitheliomata, and several interesting cases of this type are reported in the literature. Scheuermann reported the case of a girl, 3 months old, with a tumor composed of ganglion cells and many neuroglia fibers, lying in the sacral region and pressing against the rectum. The tumor was removed, and the child made a good recovery. In a group of four cases seen by Engelmann, three of the tumors occurred in the female and one in the male. One patient, a girl of 4 months, had a tumor extending from the coccygeal region to the anus, which was removed; death resulted on the following day. The growth was composed of tentacle-like processes associated with cysts which surrounded the rectum. On microscopic examination glial and connective tissues were found. Another patient, a girl 6 days old, had a large tumor of the anterior sacrum with two attached cysts. In the large cyst glial masses were found. The small one contained long and transverse bundles of collagen-like tissue with simple or cylindrical epithelium, and papillary excrescences.

An interesting case was reported by Pearse. A man, 63 years of age, complained of pain in the lower bowel and over the tip of the spine, with painful defæcation. A large cystic non-movable tumor anterior to the sacrum was removed through a posterior incision. The growth was limited by the peritoneum and involved the gluteal muscles. A diagnosis of Middeldorpf tumor of neural origin was made. Three definite recurrences were noted in this case; following several excisions and roentgen-ray treatments, the patient was reported well 1 year after the last operation.

The remnants of the notochord are sometimes considered a source of these tumors. They are usually found at postmortem chiefly at the base of the skull and on the coccyx; they have also been demonstrated on the dorsum sellæ, the hypophyseal fossa, and more rarely on the sacrum. Some of the tumors diagnosed chordoma, and supposedly arising from the notochord, are very malignant. Daland reported 16 cases of chordoma, 5 of which were in the coccygeal region, and caused pressure on the rectum. Three patients were operated on twice, and all died. One patient died from recurrence following the first operation; one had no recurrence after a successful removal of the growth. As a rule these tumors do not metastasize, but tend to invade the rectum. Lund's patient, a woman, aged 60 years, died following the removal of a smooth, round, elastic tumor, diagnosed chordoma. The growth was composed of colloid with embedded strands of epithelial cells. She had complained of pain and pressure symptoms over the sacrum and rectum with occasional incontinence of urine and fæces.

The presence of nerve tissue interspersed between the epithelial and connective tissue elements has been attributed by Herrmann and Tourneux to a persistence of the medullary coccygeal vestige. They believe that the proliferation of the ependyma and neuroglia are capable of producing cystoid or adenomatous growths, as well as the form called neuro-epithelioma. Borst and Mallory agree that these coccygeal vestiges are largely responsible for dermoid structures in the region of the sacrum and coccyx. Law reported a case diagnosed malignant neuroblastoma which might be considered in this group. The patient, a girl of 16, was pregnant and at full term. After 24 hours of labor the

head was not engaged. Examination revealed a hard, fixed, tense, non-elastic mass in the pelvis, and cæsarean section was performed. Because of firm fixation posteriorly, it was necessary to perform complete hysterectomy, at which time the sacral tumor was recognized. It was removed later through a posterior incision. The girl died a year afterward from local recurrence.

The theories concerning regional anomalies and development from collections of undifferentiated cells, which by the multiplication of their elements form the mammalian tail, must also be considered. Impregnated polar bodies or wandering blastomeres, early thrown out of the complex, single blastomeres with a secondary parasitic embryo, overproduction of granules of segmentation, and high differentiation of the posterior portion of the embryo, have been mentioned. Other structures must also be considered as possible sources of these tumors, such as the coccygeal gland, the end of the dorsal chord, the last caudal segment of the embryo, and Hensen's nodules.

The Marchand-Bonnet theory accords a genetic equality to all composite dermoids, embryons, and parasites. Many authors have chosen the postanal gut as a rather common source of sacral tumors. The growths usually resemble those described by early writers as congenital cystic sarcomata, and are composed of closed vesicles lined with glandular epithelium, sometimes cubical and sometimes columnar in type. The cysts are filled with a ropy glue-like mucus, and vary in size from 4 centimeters in diameter to the smallest space visible to the naked eye.

Keen, Bland-Sutton, and Middeldorpf are advocates of the postanal gut theory, and Middeldorpf was the first to describe these tumors. He reported the case of a girl, a year old, with a tumor in the region of the anus. With gradual enlargement of the tumor, a sinus discharging fæcal-like material developed. A soft mass which was not attached to the rectum could be felt, and was later removed through a Kraske incision. On examination, the growth was found to be composed of fat and connective tissue with distinct layers of mucosa and the characteristic mucous glands, submucosa, circular and longitudinal muscles, and many solitary follicles, but no serosa. The tumor probably should be classified as teratoma (the structure resembling a normal organ, the bowel) and might be considered a "parasitic fetus." Certain authors have questioned whether this might not have been a persistent postanal gut segment, resembling such abnormalities as Meckel's diverticula, œsophageal diverticula, and bronchial fistulæ. The fact that cysts are found in the sacrococcygeal region lined with epidermis or cylindrical epithelium is not unusual, when it is realized that the cells of the ectodermal plate are capable of producing epidermis as well as mucous membrane. Other sources for these growths may be found in the cloaca formations and the secondary processes resulting therefrom. Discussion has been warm over the monogerminal and bigerminal theory of the origin of the tumors under consideration. Middeldorpf and others believed that they were due to proliferations of remnants of the medullary canal, the neurenteric canal, and the hind-gut, in association with ectodermal and mesodermal inclusions, while others found difficulty in explaining, by the monogerminal theory, the more complex teratomata, when structures such as the eye, bronchus, vertebra, rudiments of intestine, or liver were demonstrated. Such evidence gave rise to the bigerminal theory, that tumors, often found at the base of the skull, in the sacral region, bladder, ovary, testicle, thorax, and peritoneum, represented an incomplete monstrosity or twin (a parasite engrafted on its autosite, or host), while the existent fetus in its early career included the products of a fecundated ovum, a suppressed fetus, so-called.

Many authorities, according to Law believe that the teratomata, or tumors that show evidences of all three fetal layers, may arise from local disturbances of development of misplaced tissue anlage, known as monogerminal tissue implantations. These tumors, according to Herrmann and Tourneux, are characterized by the existence of a fetal organ that may be connected with the development of the caudal extremity. It seems that one

tissue alone of these teratomata is able to proliferate and form a growth resembling an epithelioma or a sarcoma. Other observers believe that organs, or rests of organs which normally gradually disappear, must be present. There are many advocates for each theory. According to Herrmann and Tourneux, the advocates of the monogerminal theory are Lotzbeck, Braune, von Bergman, Borst and others (reported) by Frank, Ritschelt, Nasse, Linser, Steinthal, Kiderlen, and Wieting. The advocates of the bigerminal theory are St. Hilaire, Foerster, Brissaud and Monad, Dareste, Panum, Calbet, Hagen, Law, and Henning.

Many interesting cases of teratomata are reported in the literature. Schramm reported a case of a girl, aged 7 weeks, with a congenital rapidly growing tumor between the rectum and sacrum. The growth was composed of fat, nerve and muscle fibers, hyaline cartilage, areas resembling the wall of the stomach, and milk and sweat glands. In a case reported by Baumgartner, a girl, aged 13 days, had a sacrococcygeal tumor containing two legs, a pelvis and a loop of intestine. Keen and Coplin reported the case of a child, aged 2 years, with a congenital sacral tumor with a sinus that drained fæcal-like material and communicated with the rectum. The sinus wall histologically resembled a bronchus. Roentgen-ray examination revealed an opening in the lower sacrum, with two lateral projections or attempted duplications, and shadows suggesting the possibility of an incomplete humerus, forearm, and possibly a hand. The child was operated on and recovered.

A great variety of structures may be present in these tumors. as evidenced by the case reported by Frank, of a woman, aged 23 years, who at the ninth month of pregnancy, was rapidly delivered of the head and shoulders of her child, with the escape of a large amount of brown watery fluid. The delivery was completed without incident. Examination of the child revealed a circumscribed, bluish, skin-covered tumor with several yellowish-white viscid-fluid discharging fistulæ in the sacral region. Recovery followed the removal of this tumor, which was composed of cysts filled with brownish-yellow fluid, and areas resembling liver, adrenal and salivary glands, with a thin section of skin along the margins. A diagnosis was made of a true teratoma. In the growth were found structures resembling the choroid plexus and various other parts of the brain, and in pairs, cornea, sclera, ciliary body, retina, and choroidal epithelium. Skin, voluntary muscle, a small kidney, an adrenal with chromaffin, pharyngeal clefts, some intestinal tissue, liver, pancreas, salivary glands, heart, and blood vessels were also observed. There was no evidence of the formation of lungs or genitalia.

In Law's case, a man aged 27 was operated on, and a hard, smooth, rounded tumor, almost filling the pelvis, was removed from the sacrum. The patient died from a local recurrence in 3 months. Because of the fact that one area contained prostatic tissue, the question arose as to whether or not the tumor might be a teratoma of prostatic origin.

C. H. Mayo holds a very liberal view of the origin of these tumors. He believes that teratomata from the coccygeal body are also found in the sacral region, that the mucous membrane comes from the postanal gut, the nerve tissue from the neural tube, and the bone and cartilage from the coccyx and various inclusions of the surrounding tissue. Some of the growths have mucous cysts lined with ciliated epithelium from the neural tube, showing the misplacement of tissue to have occurred before the third month of gestation. According to W. J. Mayo many of these tumors really belong to the teratomata or the group which develop from the vestigial structures. The great shifting about of structures in this region in embryonic life is an important factor. The digestive tract, for example, at first lies behind the spine, but later adjusts itself so that it lies anteriorly. Because of the intimate relationship between the neural and intestinal tracts, it is not difficult to realize that the carcinomata in this region might arise from the gut, while the ependymal cell tumors might arise from the neural tract.

Very little has been said concerning the origin of the foreign body giant cell tumors that are found in the sacrococcygeal region.

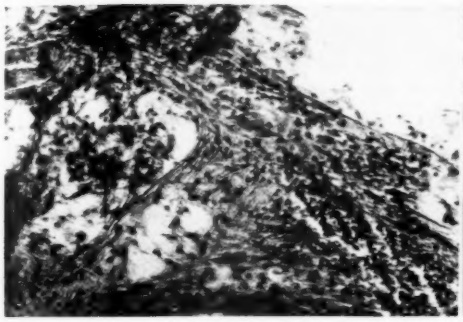

Fig. 1. (Case 1.) A photomicrograph showing ependymal cell glioma (×100).

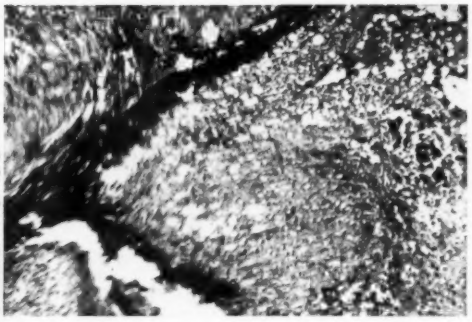

Fig. 2. (Case 3.) Ependymal cell glioma with masses of fibril formation (×50).

It may be well to explain the terminology, which is not intended to signify that the tumor is the reaction of the tissue to a foreign body. Mallory says that giant cells of at least two different types occur in tumors. One type results in multiple mitoses, and is a true tumor giant cell. It signifies rapid growth and may occur in a variety of malignant tumors. The second type he believes to be due to endothelial leucocytes invading tumors, especially those involving bone, and fusing to form foreign body giant cells They are not tumor cells (although the tumors containing them are the ones which receive the name of giant cell sarcoma), and usually signify only erosion and disintegration of bone. Broders asserts that the foreign body giant cell has a definite purpose, namely, to absorb foreign material, and may be compared to an osteoclast. He differentiates the cells by the fact that the true tumor giant cell has large irregular nuclei, and often a mitotic figure. The fact that a tumor containing foreign body giant cells destroys bone does not necessarily mean that it is malignant. Several such tumors were found in our series of cases.

Cases also have been noted in which a definite origin of the tumor was not discovered. Pollosson mentions the case of a woman, 25 years of age, who had had several normal deliveries, whose menses stopped and constipation became marked. She had severe pain in the right thigh resembling sciatica. A tumor, palpable on rectal and vaginal examination, was removed retroperitoneally; it was believed to be a sarcoma. The right ovary was found to be normal, the left was absent.

The simpler dermoids usually arise from areas, where, during embryonic life coalescence takes place between cutaneous surfaces. These are called "sequestration dermoids," while the rarer types which seem to arise in obsolete canals are called "tubulodermoids." Numerous such cases, containing hair, sebaceous material, and other characteristic contents, in some cases weighing as much as 14 pounds, have been reported.

Some of the ventral tumors of the sacrum have proved to be connected with the men-

Fig. 3. (Case 4.) Cross section of ependymal cell glioma.

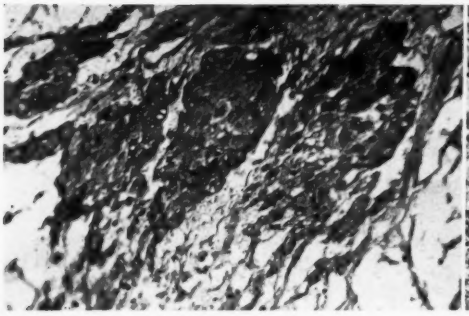

Fig. 4. (Case 4.) Ependymal cell glioma with cells resembling carcinoma (×100).

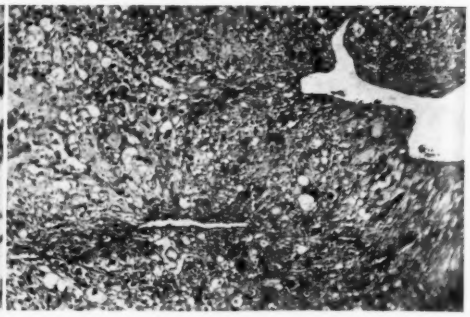

Fig. 5. (Case 5.) Ependymal cell glioma (×50). The tumor recurred 6 months after operation.

inges, the so-called "meningocele sacralis anterior." In several instances the tumors have been drained of clear fluid, and death followed soon. Bouchot reported that a woman, aged 70 years, had hydatid cysts on the anterior sacrum, and a large cyst in the liver.

PATHOLOGY

Tumors of the ventral sacrum, especially dermoids, possess much the same character as those on the dorsum, except that they are usually larger. Often there is nothing to suggest their presence externally. They tend to erode the bone, and the neural side always shows greater evidence of pressure than the rectal side. Occasionally these growths may occur as surgical surprises, and may attain large dimensions, extending upward behind the pelvic peritoneum, and causing intrapelvic pressure symptoms. As a rule they never extend upward above the posterior-superior margin of the gluteal muscles. The larger ones seem to develop forward toward the pelvis and downward between the legs, displacing the genitals and anus downward and forward. In the growth forward they press the uterus up without spreading the broad ligaments. It is possible that the tumors may extend deeply between the vertebræ and cause paraplegia by pressure on the cord. As a rule they are smooth and sharply defined.

Fig. 6. (Case 7.) Cross section of dermoid cyst.

Early writers believed that malignancy was the rule; some cases were definitely malignant, as evidenced by the fact that local recurrences were sometimes found following removal of the tumor. Metastasis was relatively uncommon. Because of the fact that these tumors often contain mammary and testicular tissue, there is a tendency for some of them to undergo malignant change (Murphy). The few reported cases of chorio-epithelioma in teratoids, warrant the assumption that malignant transformation is possible. Broders does not believe that metastasis occurs, but that death is caused by infiltration. The prognosis is bad because of the location, since

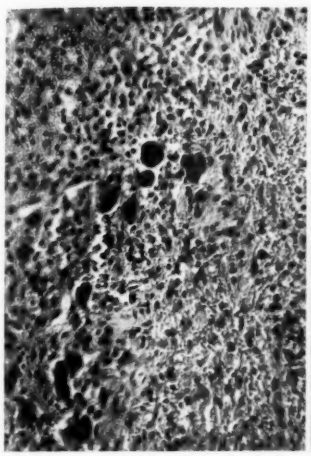

Fig. 7.

Fig. 8.

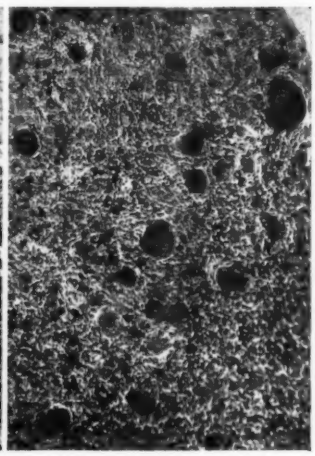

Fig. 9.

Fig. 7. (Case 10.) Foreign body giant cell tumor (×100).
Fig. 8. (Case 11.) Foreign body giant cell tumor (×50).
Fig. 9. (Case 12.) Foreign body giant cell tumor (×100).

the tumors may extend along the cord and cause death by pressure. According to Pearse, the growths are malignant and of the nature of carcinoma, traveling along the lines of blood supply, with metastasis supposedly into the muscles, fascia, and fatty tissues, oftener than into the lymph nodes. The tumors near the skin were believed usually to be simple dermoids; those higher in the pelvis were considered more complex and rare. Attention has been called to the danger resulting from injury and infection if patients were not operated on. Sudden enlargement may be due to infection, or to neoplastic activity. Because of the proximity of the meninges, infection especially must be guarded against.

SYMPTOMS

Constipation is often the only symptom. Pain in the sacral region, and down the thighs, suggesting the picture of sciatica, is fairly common. The pressure in the pelvis may be the first indication of pathological change. Often there are no symptoms, and the tumor may first be suspected in connection with difficult labor. The first indication of a growth may be suppuration with sudden drainage into the rectum, bladder, or vagina, or even into the perineum.

DIAGNOSIS

In cases in which spina bifida is associated, it is sometimes difficult to decide clinically between a spina bifida sac, meningocele, myelocele, myelomeningocele, hydrorachis, and dermoid. Differentiaton must also be made of fibroids, ovarian cysts, intraligamentous cysts, ischiorectal abscesses, congenital dorsosacral herniæ containing bowel and bladder, lymphangiomata, angiosarcomata or peritheliomata, and simple lipomata. The roentgen-ray is of diagnostic aid, especially in clearing up the diagnosis of spina bifida.

TREATMENT

Most authors advise removal of the growth when possible. Murphy advised careful complete dissection and removal, because he believed the structures to be embryonic in origin, and potentially malignant. According to Scheuermann, the operation is more successful after the first year of life. Of 42 patients operated on after the first year, 33 lived; of 17 patients under one year, 9 lived. For a time these cases were considered unfavorable for operation because of the difficulty of approach by the anterior incision and the danger of hæmorrhage. Since the Kraske procedure has been instituted, of opening the

Fig. 10. (Case 13.) Cross section of myosarcoma.

pelvis posteriorly by resection of the coccyx and lower sacrum, much more satisfactory results have been obtained. The approach is easy, and provides freedom from disturbance of the other organs. According to W. J. Mayo, early surgical intervention is the proper form of treatment. He recommends the posterior approach with rapid removal of the growth, which should be thoroughly scraped away. Hot packs are usually required to

Fig. 11. (Case 13.) Myosarcoma (×100).

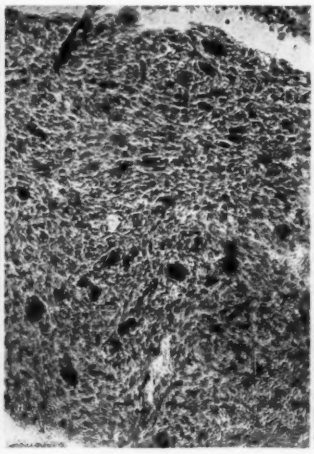

Fig. 12. (Case 14.) Sarcoma with foreign body and tumor giant cells (×100).

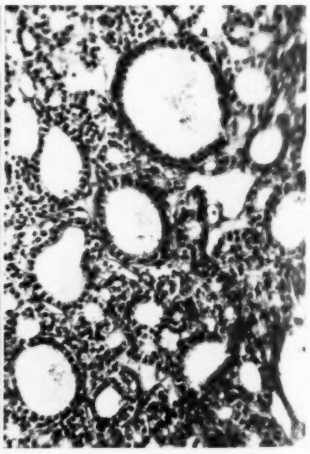

Fig. 13. (Case 15.) Adenocarcinoma (×100).

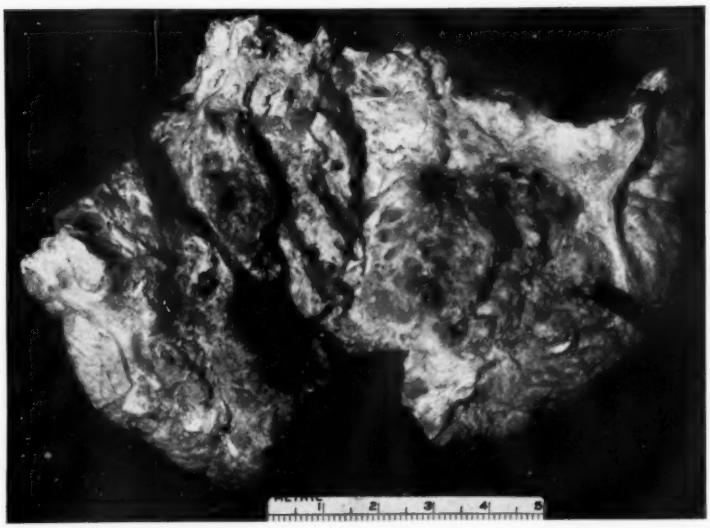

Fig. 14. (Case 16.) Cross section of colloid carcinoma.

check the bleeding, and the wound is then packed with gauze. Extensive radium radiation is applied after the operation.

Favorable results have been reported by Coley with the use of the mixed toxins of erysipelas and *bacillus prodigiosus*. In successful cases the effect is usually promptly noticeable, as evidenced by the fact that the tumor becomes smaller, is more easily movable, and less vascular. In a case reported by Massey, a young woman aged 26, with fibrosarcoma of the ventral surface of the sacrum, was treated with massive disseminations of mercuric ions with a strong electric current, and the tumor disappeared.

CASES REPORTED FROM THE MAYO CLINIC

Nineteen definitely proved cases of tumors ventral to the sacrum were observed. Eight additional cases were diagnosed clinically, but were not included in the series, either because they did not come to operation, or because the diagnosis was not satisfactory from specimens removed.

CASE 1. (A344519.) Mr. E. A. T., age 47, registered at the Clinic December 27, 1920. For the last $2^1/_2$ years he had suffered from pain in the rectum, coming on in spells, usually worse at night, and lately requiring morphine for relief. Constipation had been distressing for 18 months. Fifteen months before examination he became unable to void, and had since catheterized himself every day. For the last 4 months he had had crampy pains down the legs and slight numbness around the rectum and genitalia. There was no loss of weight. Pus and blood cells were occasionally found in the urine. On rectal examination a hard, non-tender, smooth, globular mass was felt posteriorly, apparently attached to the sacrum. A roentgenogram of the sacral region was negative. January 3, 1921, laparotomy was performed and the mass in the sacral region explored. No evidence of metastasis was found, and the wound was closed. January 21, 1921, a large glioma which had eroded the coccyx and part of the sacrum was removed through the Kraske incision. The greater part of the tumor was composed of a jelly-like substance, which was removed with difficulty. Microscopic examination revealed ependymal cell glioma (Fig. 1). The patient's convalescence was uneventful. Roentgen-ray and radium treatments were administered. In August, 1922 (19 months after operation), the patient had gained 16 pounds and was still taking roentgen-ray treatments. The function of the bowels and bladder was disturbed. The patient's health was rather poor, and there was still slight drainage from the wound.

CASE 2. (A158405.) Mr. S. K. W., age 68, registered at the Clinic April 27, 1916. He had had difficulty in urinating, and nocturia for 3 weeks. For 1 month he had been constipated and bothered with hæmorrhoids. There was slight pain in the left sciatic region. A trace of albumin was found in the urine. Rectal examination revealed moderate

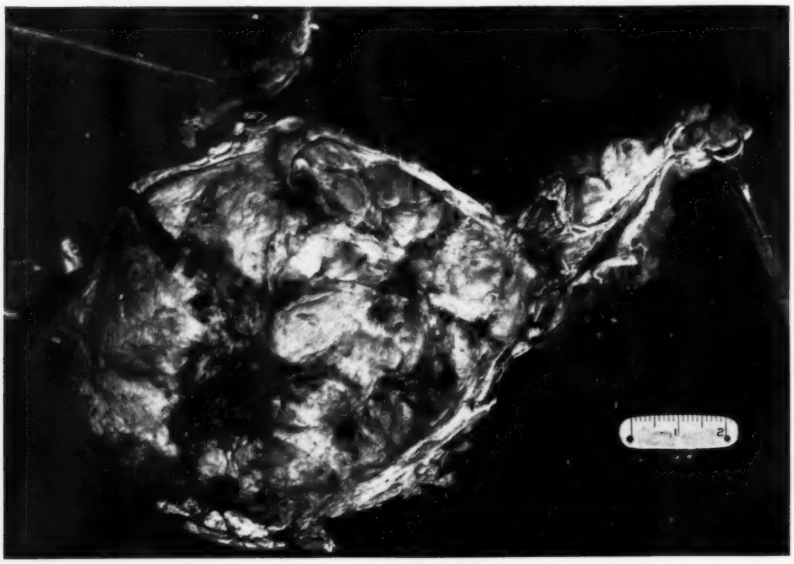

Fig. 15. (Case 17.) Myoma.

enlargement of the prostate, but the gland was uniform in size and consistency. There were a few small hæmorrhoidal tags. The patient was seen again in 8 months. The pain had become quite severe at night, mainly in the region of the left sciatic nerve. A diagnosis of tumor of the sacrum was then made. Roentgenograms revealed destruction of the middle portion of the sacrum. At operation, November 28, 1916, an inoperable growth of the sacrum, extending into the rectum, was found. The sacrum consisted of a shell of bone filled with old clots. A large piece of gelatinous tissue, on microscopic examination, proved to be part of an ependymal cell glioma. The patient's convalescence was uneventful. The tumor increased rapidly in size in the next 2 months. In January, 1918, 14 months after operation, the patient died of intestinal obstruction.

CASE 3. (A40195.) Mr. D. C., age 33, registered at the Clinic July 12, 1910. Operation for hæmorrhoids and a curettement of an ulcer of the rectum had been performed elsewhere, at which time a tumor (of the rectum) was found. The patient came for examination of this growth. He had been constipated for the past 2½ years. Pain, severe enough at times to require morphine, had been present in the sacral region. A peculiar nervous sensation from the knees to the toes had been present for the last few days. Eight pounds in weight had been lost. On rectal examination a large rounded mass was felt

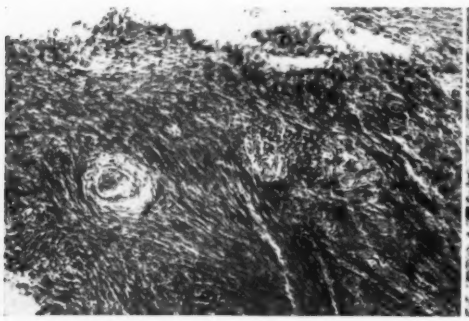

Fig. 16. (Case 17.) Myoma (×100).

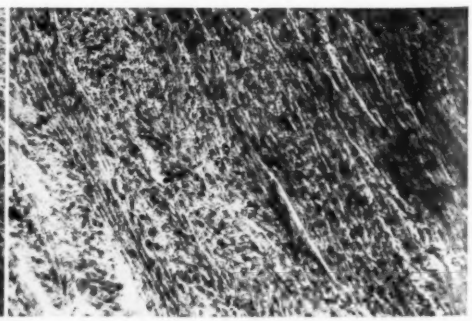

Fig. 18. (Case 18.) Cellular myoma (×100).

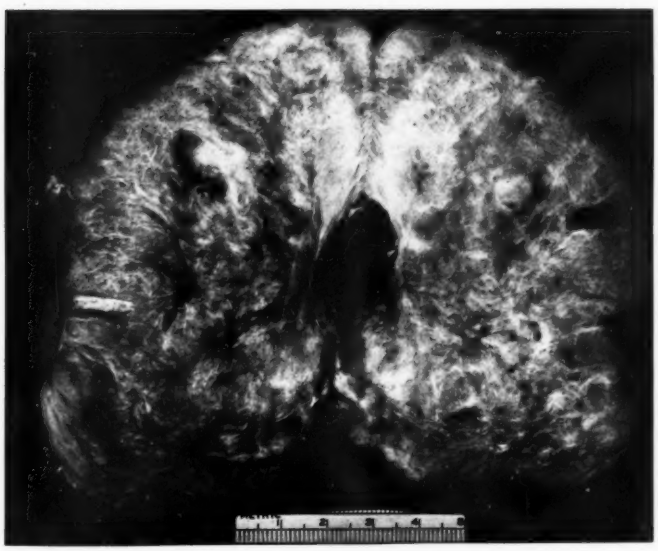

Fig. 17. (Case 18.) Cross section of myoma.

to the left, and filling the hollow of the sacrum. July 14, 1910, a tumor, pressing on the rectum and apparently having its origin from the periosteum of the sacrum, was removed through a Kraske incision. The wound was packed with gauze. Microscopic examination revealed an ependymal cell glioma (Fig. 2). The patient's convalescence was uneventful. Extensive radium radiation was carried out, and Coley's serum administered. The patient gained 25 pounds in the first year after operation. In March, 1917, he was unable to void, and catheterization was necessary. Obstipation was marked. Later a movable, non-tender mass became palpable in the suprapubic region, and an extensive mass was felt by rectal palpation. The patient died May 18, 1919, 8½ years after the operation.

Case 4. (A81523.) Mr. W. E., age 44, came to the Clinic March 17, 1913, complaining of a recurrent tumor of the back. He had fallen, striking on the lower spine, 15 years before. Six years before a "fatty tumor" had been removed from the lower part of his back. A growth recurred in 1 year, and was "burned out" 2 years later. The present growth in the sacral region, 3 centimeters in diameter, had developed 2 years before. On rectal examination a tumor 5 centimeters in diameter, could be felt, pushing the rectum forward. March 20, 1913, an irregular tumor measuring 10 by 12 centimeters attached to the periosteum of the sacrum and extending to the bowel, was removed (Fig. 3). A diagnosis of ependymal cell glioma was made on microscopic examination (Fig. 4). The patient's convalescence was uneventful. In August, 1922, 9 years later, the patient was perfectly well.

Case 5. (A320205.) Mr. A. S., age 38, registered at the Clinic June 16, 1920. Three years before, he had injured his rectum with a spike. He complained of pain after sitting, and of increasing constipation during the last 3 months. A diagnosis of a "growth of the rectum" had been made elsewhere and a colostomy advised. Ten pounds in weight had been lost. On rectal examination a large, round, fairly firm, non-fluctuating mass was palpated between the rectum and the sacrum. June 30, 1920, a large, soft tumor, apparently honey-combing the anterior surface of the sacrum, was removed through a Kraske incision. There was much oozing, and the wound was packed with gauze. Microscopic examination revealed an ependymal cell glioma (Fig. 5). The patient's convalescence was uneventful. Roentgen-ray and radium treatments and Coley's serum were given. In April, 1922, an operation, its nature not known, was performed elsewhere. In August, 1922, 2 years after the first operation, the patient had lost 21 pounds. The tumor recurred 6 months after operation, but gave rise to no discomfort.

Case 6. (A137596.) Mrs. J. F. D., age 67, registered at the Clinic August 3, 1915. She complained of a small tumor at the end of the spine, which had been present for 30 years and was causing moderate discomfort. The tumor had grown slightly during the last 3 years. Discomfort in the coccygeal region had been growing increasingly worse the last 8 months. There was considerable aching in the left hip and thigh. Roentgenograms of the lower spine revealed apparent destruction of the fifth lumbar vertebra, probably due to old Pott's disease. Rectal examination revealed a

regular, elastic, movable mass posteriorly. September 3, 1915, a tumor measuring 8 by 8 centimeters, and made up of two separate compartments (intimately associated with the rectum) was removed from the hollow of the sacrum. The pathologist reported the tumor to be a postanal dermoid containing cholesterin. The patient's convalescence was uneventful. No roentgen-ray, radium, or serum treatments were given. In August, 1922, 7 years after operation, the patient reported that 2 years previously the tumor had recurred. It had increased somewhat in size and was painful at times. The function of the bladder and bowels was slightly disturbed.

CASE 7. (A117710.) M. H., a girl, age 3, was brought to the Clinic October 22, 1914, on account of a small lump over the lower spine. The mass was first noticed when the child was 3 weeks old; recently it had increased in size. A non-tender, cystic mass measuring about 4 by 7 centimeters with a hard area in the center, was found in the lower coccygeal region. October 26, 1914, a postanal dermoid with two compartments, one extending into the pelvis and the other into the buttocks, was removed (Fig. 6). The child's convalescence was uneventful. No answer has been received to a letter of inquiry concerning the patient.

CASE 8. (A110123.) Miss B. K., age 19, registered at the Clinic July 9, 1914. The patient was born with a small lump on the lower spine; this grew slightly and was drained when she was 14 years of age; a large amount of "pus" was removed. It was drained again 1 year later. She came to the Clinic because of draining sinuses in the coccygeal region. On examination several old discharging sinuses were found posterior to the anus. Rectal examination revealed a small mass posteriorly not connected with the coccyx. July 21, 1914, a large multilocular infected cyst, lying against the sacrum, was removed through the old scar. The tumor was closely adherent to the rectum and extended laterally to the vagina, measured 10 by 12 centimeters, and had many fistulous openings. On examination it proved to be a dermoid cyst. The patient's convalescence was uneventful. In August, 1922, 8 years after operation, the patient was entirely well and had gained twenty-five pounds.

CASE 9. (A379846.) Mrs. E. N., age 32, registered at the Clinic December 17, 1921. Appendectomy, myomectomy, and bilateral salpingo-oöphorectomy had been performed elsewhere 3 years before. The patient complained of nervous headaches and pain in the lumbar spine, especially on stooping. Examination of the rectum revealed a small mass to the right and posteriorly. Roentgenograms of the sacrum revealed nothing abnormal. December 28, 1921, a thin-walled cyst measuring 8 by 8 centimeters, situated to the right and behind the rectum, and apparently not communicating with the bone, was removed through a posterior incision. A portion of the levator ani muscle was sacrificed. The cyst proved to be a dermoid lined with squamous epithelium and containing a thick brownish substance. The convalescence was uneventful. In August, 1922, 8 months after operation, the patient had gained 15 pounds in weight and was perfectly well.

CASE 10. (A378393.) Mrs. C. S., age 36, came to the Clinic November 28, 1921. She had complained of pain in the legs, weakness, and pain in the lower back on bending, for the last 14 months. Her legs acted slowly and tired easily. There was no loss of weight. Examination revealed a large tumor in the pelvis, projecting forward from the sacrum. Roentgenograms of the lower spine were suggestive of a tumor of the pelvis, with possible involvement of the sacrum. December 1, 1921, a growth measuring 16 by 22 centimeters, very soft, bloody, and friable, was removed through a Kraske incision. The wound was packed with gauze and the patient transfused. On histological examination a diagnosis of foreign body giant cell tumor was made (Fig. 7). During the convalescence the patient developed an ischiorectal abscess which was drained three times, an anal fistula which was operated on three times, and an abscess of the buttock, which was also drained. Extensive radium radiation was used. In August, 1922, 9 months after the operation, the patient was apparently well, and was working. She returned to the Clinic for examination at that time and no evidence of recurrence was found. There was still slight drainage from the wound.

CASE 11. (A68668.) Mrs. H. L. V., age 57, registered at the Clinic June 4, 1912. One month before, her anal sphincter had been dilated for a fissure. She had had almost complete obstruction of the bowels for 5 months, following a sudden profuse hæmorrhage from the rectum. There was tenderness in the pubic region, and pains radiated from the sacral region to the thigh and vagina. There was slight urinary incontinence. On examination a tumor was found posterior to the rectum. June 11, 1912, a mass measuring 8 by 10 centimeters, which had perforated posteriorly, and involved the third, fourth, and fifth sacral vertebræ, was removed through a Kraske incision. Some of the tissue was soft, and was scraped out of the hollow of the sacrum. The wound was packed with gauze. Microscopic examination revealed a foreign body giant cell tumor (Fig. 8). The patient's convalescence was uneventful. Later roentgen-ray treatments and numerous injections of Coley's serum were given. In August, 1922, 10 years after operation, the patient had gained 10 pounds and had not noted a recurrence. She was markedly constipated, and it was necessary to use enemata. Because of pain and swelling in the right knee, crutches were used.

CASE 12. (A284067.) Mrs. E. R., age 27, came to the Clinic August 12, 1919. For 10 months she had had stiffness in the back of the legs with soreness over the lower spine. Later tingling and pricking sensations appeared in the legs, and standing was difficult. Occasional pains were present in the left lower abdomen. Twenty pounds in weight had been

lost. On rectal and vaginal examinations, a large, firm, rather tender, nodular mass was found lying against the sacrum. August 25, 1919, an encapsulated growth measuring 10 by 12 centimeters was found behind the rectum and extended down to the level of the internal os. While the growth was being removed, considerable bleeding occurred, because of extensive erosion of the anterior surface of the sacrum. The patient was in poor condition, and died shortly after the operation. Microscopic examination of the growth revealed a benign foreign body giant cell tumor (Fig. 9).

CASE 13. (A353927.) Mr. J. W. B., age 64, registered at the Clinic March 30, 1921. He complained of having had sharp, shooting pains in the rectum, and pain in the lower abdomen for the last year. There had been gradually increasing constipation, and frequency of urination for 14 years; 1 month before, there had been almost complete retention. Eighteen pounds in weight had been lost. Examination of the abdomen revealed a mass in the lower quadrant, near the middle line. A large, hard, smooth, immovable mass was found to the right of the prostate, extending up behind the bowel and filling the hollow of the sacrum. April 11, 1921, a tumor measuring 10 by 14 centimeters was cleanly removed through a posterior incision, with the exception of a small portion of the capsule which was adherent to the anterior surface of the sacrum (Fig. 10). A diagnosis of myosarcoma was made on microscopic examination (Fig. 11). Radium needles were inserted at the site of the growth and the wound packed with gauze. There was slight postoperative hæmorrhage and a transfusion of 500 cubic centimeters of citrated blood was given. The patient improved and gained weight. He returned home, and in spite of extensive roentgen-ray and radium treatments gradually became weaker. Later a mass was reported palpable in the pelvis, behind the bladder. The patient died March 4, 1922, 11 months after operation.

CASE 14. (A192214.) Miss E. B., age 19, came to the Clinic April 24, 1917. She had always had a great deal of pain with menstrual periods. In October, 1916, a shortening of the uterine ligaments and appendectomy were performed without relief of the pain. She also complained of pain in the lower back, of 5 months' duration; this was especially noticeable on walking. Lately she had had rather severe pain in the left hip, extending down the legs. She had lost 23 pounds in weight. On vaginal examination a large, firm, compressible mass, painful on pressure, was found in the center of the pelvis. Considerable tenderness was present over both sciatic nerves. Roentgenograms of the lower spine revealed an unusual prolongation of the first sacral transverse process. April 30, 1917, a soft, semifluctuating, encapsulated, freely-bleeding mass was removed from the anterior surface of the sacrum through the old abdominal incision, and a glass tube inserted for radium treatments. The patient bled a great deal and was given 800 cubic centimeters of normal saline intravenously. On microscopic examination of the tumor a diagnosis of sarcoma with foreign body giant cells and mitoses was made (Fig. 12). The patient's convalescence was uneventful; under roentgen-ray and radium treatments she progressed nicely until June, 1917, 2 months after the operation, when she became unable to walk and complained of pain in the legs and back. She gradually became weaker and died June 28, 1918, 14 months after the operation.

CASE 15. (A174820.) Mrs. G. M., age 40, registered at the Clinic October 9, 1916. She had had a difficult labor with the birth of her first child, 5 years before; her second labor, 2 years before, had been normal. Eighteen months before, she had fallen on her coccyx, and had pain in the coccyx and down the left thigh. This pain was worse during pregnancy. Labor had been induced at the eighth month, after a rectal examination which revealed a tumor 5 by 7.5 centimeters anterior to the sacrum. The tumor, which had appeared cystic, was reduced about one-half in size and became firm after the labor. Slight urinary incontinence had been noticed since the delivery, and the bowels moved with difficulty. October 16, 1916, a laparotomy was performed and both internal iliac arteries were ligated. A small fibroid was removed from the back of the uterus, and the fundus stitched to the posterior pelvic peritoneum. October 27, 1916, 11 days later, a vascular flattened tumor measuring 9 by 11 centimeters, eroding the sacral periosteum, was removed through a posterior incision, and the wound packed with gauze. Microscopic examination of the tumor revealed adenocarcinoma (Fig. 13). The patient's convalescence was uneventful, except for the development of several small ischiorectal abscesses. Radium treatment was instituted. In September, 1918, 2 years later, the patient reported that 6 months before, she had developed scoliosis and kyphosis in the lower dorsal region, with severe pains in the back. A plaster cast afforded slight relief. Later, signs of paralysis developed, but there was no obvious recurrence.

CASE 16. (A274670.) Mrs. L. C. L., age 49, registered at the Clinic June 12, 1919. She had had seven operations in the last 20 years for rectal abscesses, fistulæ, and hæmorrhoids. She complained of fistulæ which were still present posterior to the rectum, and also of loss of weight and strength. On examination a small opening was found at the tip of the sacrum, draining pus. At operation, June 14, 1919, a specimen was removed for diagnosis, and a week later a tumor measuring 14 by 16 centimeters with two discharging sinuses was removed from the hollow of the sacrum (Fig. 14). On microscopic examination of the tumor a diagnosis of colloid carcinoma was made. The patient's convalescence was uneventful. Numerous roentgen-ray and radium treatments were given. In August, 1922, 3 years after operation, the patient had gained 50 pounds in weight, and had no evidence of recurrence.

CASE 17. (A274449.) Mr. W. M. J., age 37, came to the Clinic June 11, 1919. His back had been injured in a mine 12 years before, and for the last 5 years he had complained of almost constant, rather severe pain in the lower back, radiating down the back of the left thigh and leg. He had lost 15 pounds in weight. An exploration had been performed in April, 1919, for "sarcoma of the prostate." Rectal examination revealed a mass about 8 centimeters in diameter, apparently beneath the mucosa, just above the prostate, possibly involving this structure, and attached to the right sacral wall. June 20, 1919, a perineal incision was made, and a hard, rounded, fixed tumor was felt which could not be removed at this time without great risk. The patient developed acute urinary retention, and the bladder was drained suprapubically the following day. July 18, 1919, a solid tumor measuring 9 by 12 centimeters, lying in front of and eroding the sacrum, was enucleated (Fig. 15). The tumor completely obstructed the urethra, so that it was necessary to make a permanent suprapubic cystostomy. The sacral wound was packed with gauze. A histological diagnosis of myoma was made (Fig. 16). For 1 year the patient had roentgen-ray and radium treatments and was in good health. He returned to the Clinic in November, 1921, 2½ years after operation, complaining of a return of the pain in the back and legs, with some urinary incontinence and urgency. Examination revealed a large mass in the pelvis, apparently attached to the sacrum. An enlarged inguinal gland thought to be metastatic was excised and found to be fibrous tissue. November 28, 1921, 2½ years after operation, the patient was again operated on; a large fibrous, fixed mass was found in the hollow of the sacrum which could not be removed. Radium needles were inserted. In August, 1922, 3 years after operation, the patient had gained weight and was feeling well.

CASE 18. (A327078.) Mr. E. B., age 56, registered at the Clinic July 30, 1920. An exploration had been performed in June, 1920, for a tumor in the pelvis. The patient had had an ache at the end of the spine for 4 months, becoming almost constant of late and worse when he was sitting. Rectal examination revealed a smooth, encapsulated mass posteriorly and to the right. Roentgenogram of the colon revealed a filling defect in the region of the sigmoid. August 10, 1920, a hard tumor measuring 10 by 12 centimeters was removed from behind the rectum through a posterior incision (Fig. 17). The tumor shelled out readily, and left a large bleeding space. A diagnosis of cellular myoma was made on microscopic examination (Fig. 18). The patient recovered readily from the operation, but died apparently from a recurrence, in July, 1921, 1 year after the operation.

CASE 19. (A211781.) Mr. W. M. T., age 34, came to the Clinic October 24, 1917. He gave a history of an injury to the sacrum 15 years before, when he fell against a box. For the last 1½ years he had had a dull pain in the sacrum, worse after exertion, and gradually becoming more intense; lately the pains extended into the legs and were severe enough to keep him awake. He had been operated on a few weeks before, and granulations were found in the cavity of the sacrum. The section for histological study which the patient brought with him revealed basal-cell epithelioma. There had been some relief after the operation, but the pain was still present in the buttocks and hips. The patient had lost 8 pounds in weight. On examination by rectum no tumor was palpated, but there was tenderness on pressure over the sacrum. A sinus which drained pus, and apparently had a necrotic base, was found over the sacrum. November 1, 1917, a posterior incision was made and the sacrum found to be largely destroyed, exposing the sacral plexus. The wound bled freely and was packed with gauze. The tissue removed proved to be inflammatory. The patient's convalescence was uneventful. Roentgen-ray and radium treatments were administered. The patient could not be traced in 1922.

SUMMARY

Ventral tumors of the sacrum (so-called Middeldorpf tumors) are definitely encapsulated, are usually attached to the periosteum, and tend to erode the bone. The greatest pressure is exerted on the neural, and not on the rectal side.

Remains of the lower neural canal and the postanal gut appear to form the basis for many of the ventral tumors.

There is great diversity of tissue in these growths; all the body tissues may be represented.

Opinion seems about equally divided with regard to the monogerminal and bigerminal theories of origin of these tumors.

Ventral tumors of the sacrum seldom metastasize, but cause death by infiltration.

The blood picture is practically always normal, and the urine rarely shows unusual changes. Systemic reaction of the tumors is mild.

Pain, resembling sciatica, and constipation are often the only symptoms.

The roentgen-ray findings are practically always negative.

Treatment consists of the removal or scraping out of the tumor, followed by extensive radium radiation.

Five patients with ependymal cell glioma were operated on at the Mayo Clinic. The average age of the patients was 46 years. One

patient was perfectly well 10 years after operation, and 1 showed improvement 19 months after operation, but complained of disturbance of function of the bladder and bowels. One died of recurrence 9 years after removal of the growth. An exploration was made in 1 case, which proved inoperable, and the patient died 14 months later of intestinal obstruction. One had a recurrence 2 years after operation, but without discomfort.

Dermoids were removed in four instances. The average age of the patients was 30 years. Postoperative data were obtainable in three of these. Two patients were well, one, 1 year after operation, and one, 8 years after operation. One patient had a recurrence 5 years after the removal of the tumor.

There were three patients with foreign body giant cell tumors. The average age of the patients was 40 years. One patient was apparently well 15 months after removal of the growth. Almost complete recovery was reported by another, 10 years after operation. A third patient died following operation.

Carcinomata were found in two instances. One patient, age 40, had an adenocarcinoma, and was practically well 2 years after operation. One, age 49, had a colloid carcinoma and was markedly improved after its removal.

Myomata were removed in 2 cases. One patient, age 37, was improved 3 years after operation, and one, age 56, died from recurrence 1 year after operation.

One patient, age 64, with a myosarcoma, died from recurrence 1 year after operation.

One patient, age 19, died from recurrence 15 months after the removal of a sarcoma. The growth was composed of foreign body giant cells with mitoses. One patient had an inoperable basal cell epithelioma.

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THE USE OF BOILED BEEF-BONE, INTRAMEDULLARY PEGS IN THE FRACTURES OF LONG BONES

An Experimental Study[1]

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In the hope that further light might be shed upon the desirability or the undesirability of the use of boiled beef bone as an internal splint in fractures, a study of the fate of the intramedullary boiled beef-bone peg in recent fractures in dogs was made in the experiments which follow.

A standard operation was determined upon. In the earlier cases the dogs were shaved the day before the operation and a wet, very dilute bichloride dressing was applied. Later, this was abandoned as it was felt that the prevention of infections was dependent entirely upon the care with which the preparation was done at the time of the operation, and the technique of the operation itself.

The operations, with the exception of the first few, were done under the most favorable circumstances. A hospital operating room was placed at our disposal with full complement of internes and nurses, and the same technique, or if anything a more painstaking one, as employed in human beings was used.

After completely anæsthetizing the animal with ether, the upper arm and shoulder were widely shaved and dried with alcohol and ether, and painted with full strength tincture of iodine. The animal was then draped. A longitudinal incision was made over the upper arm and the muscles retracted, care being taken not to injure the musculospiral nerve.

After the humerus had been exposed for a distance of 2 to 3 centimeters, a Gigli saw was passed under it, and the bone was sawed through at right angles to its axis. The two sawed ends of the humerus were brought up into the wound and the marrow cavity was lightly curretted out. A beef-bone peg, which had been boiled for at least 2 hours, was selected of such size as to fit tightly into the marrow cavity. It was thought best in the latter two-thirds of the experiments to use rectangular pegs in the round medullary cavity. By this arrangement there were four points of contact of the peg with the internal circumference of the bone, and the intervening areas of the endosteum were not subjected to any pressure (Fig. B).

The length of each peg was at least twice the width of the bone into which it was inserted. After both fragments were slipped over the peg and approximated, the fractured bone was held together stiffly and rigidly. The muscles and subcutaneous tissue were approximated and the skin closure was carefully done.

Collodion was painted over the wound, and after a dressing was applied a snug plaster cast was put on so as to include the neck, shoulder, back, and the entire arm except the paw. These casts were generally removed at the eighth week, and the animals were killed by ether at the desired dates.

The following are typical case histories in dogs which did not die of early infection.

Dog 6. Operation November 26, 1920. Large dog. Preparation: Shave and iodine at the time of operation. Typical operation. December 14, 1920, abrasion under the left arm has become infected and the constricting area of plaster cut away. Dog otherwise healthy. January 3, 1921, the superficial abrasions caused by the cast have become numerous and badly infected so that the hair is soaked with ill smelling pus and the cast has become softened. The cast is therefore removed on this day, the thirty-eighth postoperative. Palpation of the arm at the site of the fracture showed crepitus and abnormal mobility. As it seemed to be unwise to put on an-

[1] From the Laboratories of University of Illinois College of Medicine and the University Hospital. (For discussion, see p. 568.)

Fig. 1 (above). Dog 5. Roentgenogram 4 days after operation. Boiled beef-bone peg in place in medullary cavity.
Fig. 2. Dog 8. Roentgenogram 5 days after operation. Shows boiled beef bone in place.

other cast or to let the dog be without one, it was killed by ether. The humerus was disarticulated and removed in one piece to facilitate examination. At the site of the fracture there was a marked proliferation of dense connective tissue which formed a fibrous capsule over the two ends of the live bone. As there was considerable motion at the site of the fracture this connective tissue acted as the capsule of a false joint. About 1 centimeter from the fracture on the distal fragment was a tough projection on the bone measuring 0.3 centimeter by 0.3 centimeter by 1 centimeter and which was composed of connective tissue with probably some early bone formation. On cutting open the fibrous capsule at the fracture the boiled beef-bone peg was found to be firmly embedded in the distal fragment (doubtless the one into which it had been driven at the time of the operation). The upper end of the peg moved about freely in the marrow cavity of the proximal fragment, which marrow cavity had been eroded away so that its internal diameter was greater than it was at the time of the operation. The distal fragment and the attached bone peg were sawed through longitudinally, and the peg was seen to extend well into the cancellous part of the bone. It was in intimate contact with the marrow along its entire extent. Macroscopically there had been no absorption of the peg.

Dog 8. Operation December 10, 1920. Small black and tan dog. Preparation: On the day pre-

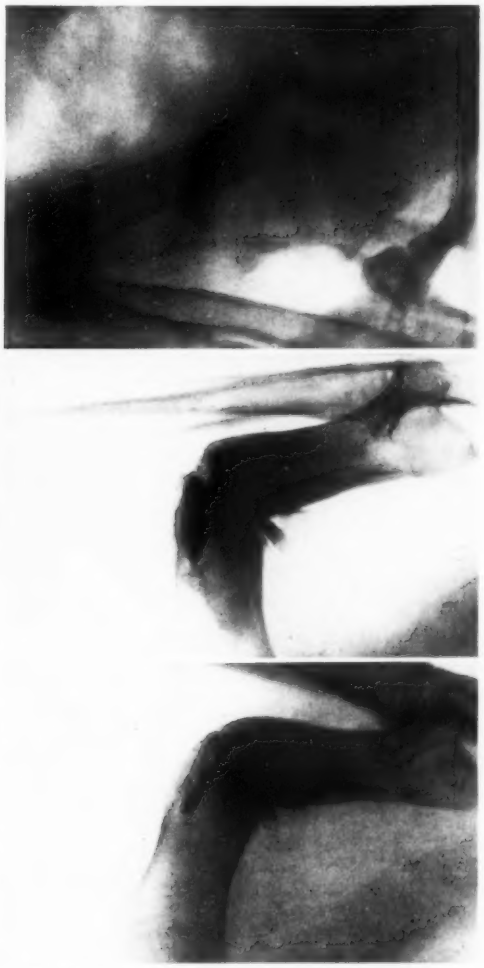


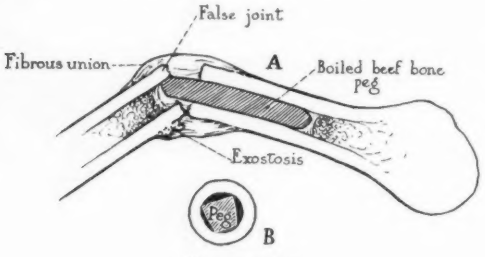
Fig. 3 (upper). Dog 12. Roentgenogram 3 days after operation. Shows fracture splinted by three boiled beef-bone intramedullary pegs.
Fig. 4 (middle). Dog 12. Roentgenogram 284 days after operation. Shaft angulated to nearly 90 degrees. Fragments of the pegs may be seen in each end of the fragments.
Fig. 5 (lower). Dog 12. Roentgenogram 377 days after operation. Firm union at the site of the fracture.

ceding the operation this dog was shaved and a wet bichloride dressing was applied. Typical operation. Dog well on January 3, 1921. February 7, 1921, dog died following a week's illness which was characterized by coughing and vomiting—fifty-ninth day postoperative. On removing the cast, the humerus was found to be bent to an angle of about 45 degrees and apparently was firmly united. Dissection, how-

Fig. 6. Dog 12. Appearance of cross section at death, 413 days after operation. Note remnants of boiled beef-bone pegs which almost have been absorbed.

ever, showed that there was a large amount of callus formation and fibrous union and that there was actually a slight amount of motion at the site of the fracture. The specimen was sawed through longitudinally and it was found that the bone peg had slipped out of its engagement in the upper fragment and in resting against the cortical margin of that fragment had formed a false joint there. There was no evidence of union between the peg and the upper fragment. The peg was firmly embedded into the lower fragment (Figure A) and macroscopically there was clear line of demarcation between the peg and adjacent marrow.

Dog 11. Operation, December 30, 1920. Small black and tan dog. Preparation: Shaved the same



Figs. A and B.

Fig. 7. Dog 12. Photograph taken just before death, 413 days after operation. Shows angular union of right humerus.

morning as the operation and skin painted with iodine at the time of the operation. In this case the humerus was fractured by means of a bone cutter instead of by the Gigli saw. As a consequence about 2 centimeters of the side of the distal fragment was broken off, the part broken out being from the bone adjacent to the main fracture. The peg was inserted with great difficulty and when in place was not very secure. After the operation the dog was unable to extend the paw of the affected arm, and the dorsum of this paw had become worn, sore, and free from hair. This was taken to be evidence that the musculospiral nerve had been injured. March 1, 1921, cast cut away from an infected wound of the forearm. March 8, 1921, dog well. March 22, cast removed. A severe infection of the chest wall had occurred under the cast. There was no union at the site of the fracture. March 23, dog died, presumably from the infection of the chest wall. The bone fragments were found to have become disengaged. There was a firm fibrous union. The bone peg was firmly united to one fragment. There was muscular and fibrous attachment to the bone peg.

Dog 12. Operation, January 7, 1921. Large St. Bernard puppy weighing about 60 pounds. Preparation: Shaved about 2 days previously and wet bichloride dressing applied. The operation was the usual one save that the marrow cavity was so large that it required three large bone pegs to fill it. On February 4, 1921, it was noticed that the dog had eaten through the cast so that it offered no support to the fracture. The cast was accordingly removed. It was found that there was an angulation at the site of the fracture of about 45 degrees and that on palpation a very faint crepitus or gritting could be made out. The dog is in excellent general

Fig. 8

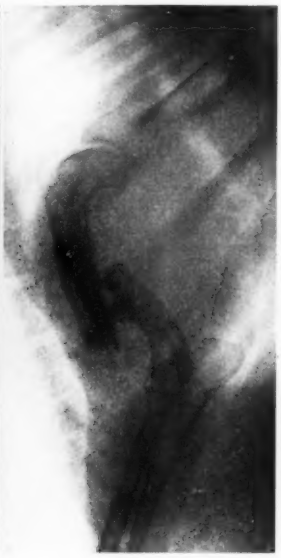


Fig. 9

Fig. 10

Fig. 8. Dog 14. Roentgenogram 7 days after operation. Shows boiled beef bone completely disengaged from one fragment and the bone ends separated. Peg evidently too short.

Fig. 9. Dog 14. Roentgenogram 106 days after operation. Showing fragments overlapping with cross union.

Fig. 10. Dog 14. Roentgenogram 354 days after operation. Firm union.

health. March 8, 1921, there may still be felt a slight crepitus: dog well. March 22, large amount of callus, dog well, union nearly firm. May 13, there is apparently a false joint at the site of the fracture. Dog well. June 10, definite false joint. Dog well. October 18, firm union, dog well. February 8, 1922, dog has good use of leg but limps slightly. February 22, 1922, killed. Macroscopically there is marked absorption of the remnants of the pegs (Fig. 6).

Dog 14. Operation, January 28, 1921. Small black and tan dog. Shaved 3 days previously and leg wrapped in a wet bichloride dressing at that time. The dog was an old one and the marrow cavity was very small. There was a good deal of difficulty in fitting a peg into this marrow cavity. February 4, 1921, X-ray examination showed the peg to be completely disengaged from one fragment and the bone ends to be rather widely separated. March 8, dog well. March 22, dog in labor and therefore cast removed. Fibrous union only. Wound clean. Five puppies born. April 8, dog well. June 10, dog uses leg and is well. February 8, 1922, dog uses leg well. February 24, 1922, killed.

Dog 15. Operation, February 4, 1921. Medium sized black and tan. Preparation 3 days before the operation, but the dog had torn off the protective dressing. Typical operation. March 22, severe infection underneath the cast. April 8, 1921, cast removed. Infected wound near the head of the shoulder from which several bone sequestra are being extruded. Union doubtful. May 13, 1921, wound practically healed. Dog well. June 10, dog well, but doesn't use leg. January 12, 1922, killed in dog fight. Pus cavity between the ends of the bone. No union. Persistence of sequestrum formation.

Dog 19. Operation, March 18, 1921. Typical operation. March 21, X-ray shows that the bone fragments have become disengaged. April 8, 1921, dog well. December 13, 1921, killed in dog fight.

Dog 22. Operation, April 15, 1921. Typical operation. Dog prepared at the time of the operation. June 24, cast removed. Dog well. February 8, 1922, dog limps. February 10, killed. The specimen showed a false joint with fibrous union. The peg was not definitely recognized macroscopically.

Dog 26. Operation, May 27, 1921. Typical operation. Dog still walked with a limp when killed on February 10, 1922. The specimen showed a false joint with fibrous union. There was no remnant of the peg visible macroscopically.

Dog 28. Operation, October 14, 1921. Preparation: shave and iodine at the time of the operation. November 1, dog well. Skin slightly abraided under the cast. February 8, 1922, dog uses leg well. February 17, dog killed.

MICROSCOPIC EXAMINATION

From 9 animals (Dogs 12, 14, 15, 19, 22, 26, 28, 29, and 31) specimens which included the

Fig. 11 (above). Dog 15. Roentgenogram 3 days after operation. Boiled beef-bone intramedullary peg in place.

Fig. 12. Dog 15. Roentgenogram 254 days after operation. Pus cavity at ends of the bone. The peg has probably been broken.

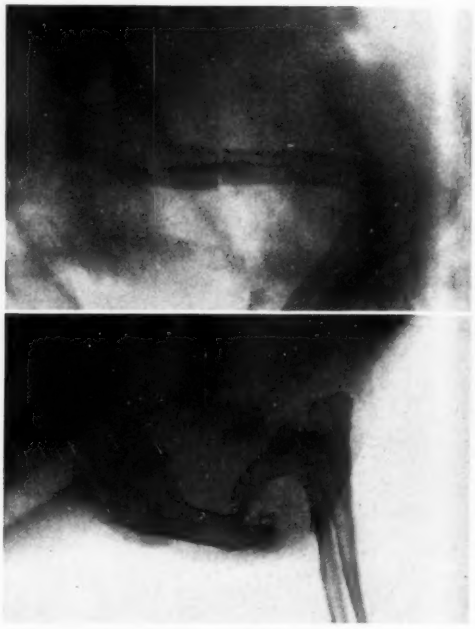


Fig. 13 (above). Dog 17. Roentgenogram 2 days after operation. Typical example of boiled beef-bone intramedullary peg. Dog died of infection 8 days after operation.

Fig. 14. Dog 22. Roentgenogram 278 days after operation. A false joint with fibrous union. Peg not recognized; has been broken after partial absorption.

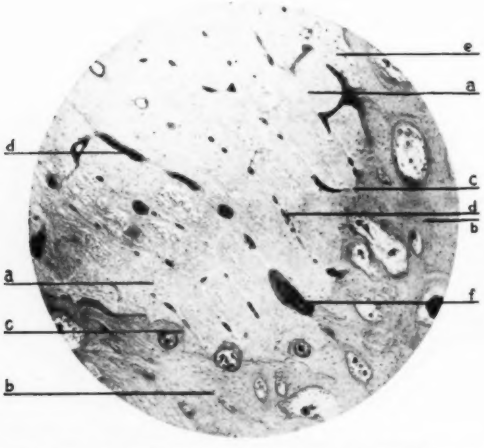


Fig. 19. *a*, Beef-bone peg; *b*, live bone; *c*, line of junction between the live and dead bone; *d*, new blood vessels which have apparently invaded the Haversian canals of the dead bone; *e*, live bone corpuscles in the borders of the dead bone; *f*, new bone formation around vessel in dead bone. (×60.)

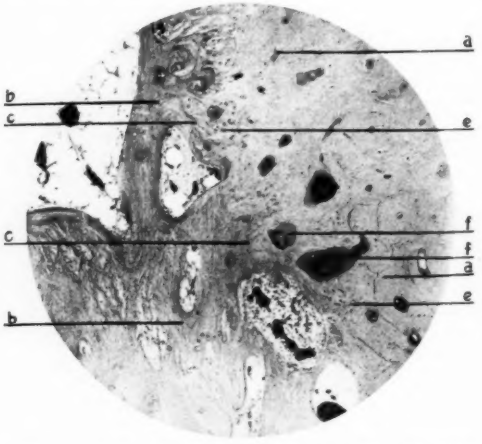


Fig. 20. *a*, Beef-bone peg; *b*, live bone; *c*, line of junction between the live and dead bone; *d*, new blood vessels in the dead bone; *e*, live bone corpuscles in the borders of the dead bone; *f*, new bone formation in the borders of the dead bone. (×60.)

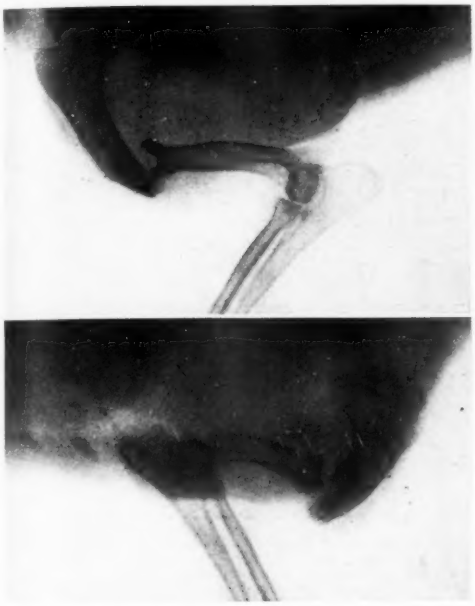


Fig. 15 (above). Dog 25. 211 days after operation. Union. Peg has been broken after partial absorption.

Fig. 16. Dog 26. Roentgenogram 204 days after operation. A false joint with fibrous union.

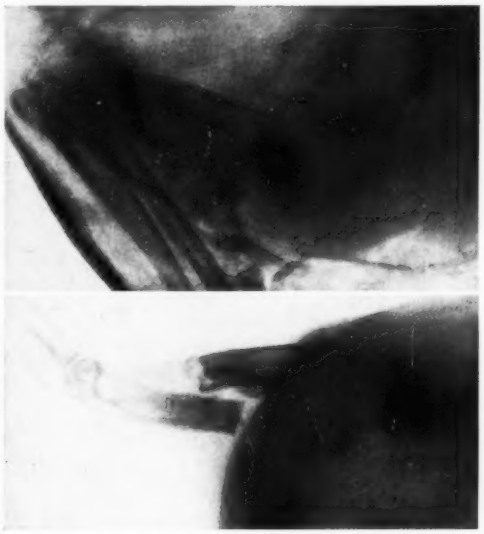


Fig. 17 (above). Dog 28. Roentgenogram 5 days after operation. This peg subsequently was broken.

Fig. 18. Dog 28. Roentgenogram 97 days after operation. Shows boiled beef-bone intramedullary peg broken after partial absorption.

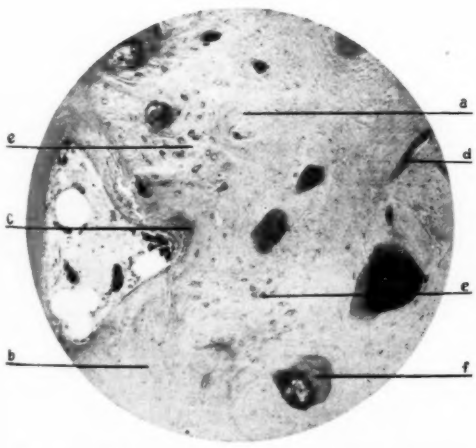


Fig. 21. *a*, Beef-bone peg; *b*, live bone; *c*, line of junction between the live and dead bone; *d*, new blood vessels in the dead bone; *e*, live bone corpuscles in the border of the dead bone; *f*, new bone formation in the dead bone. (×130.)

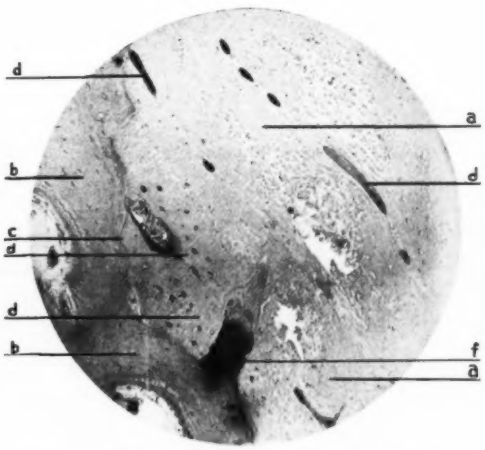


Fig. 22. *a*, Boiled beef-bone peg; *b*, live bone; *c*, line of junction between the live and dead bone; *d*, new blood vessels in the dead bone; *e*, live bone corpuscles in the borders of the dead bone; *f*, new bone formation invading the dead bone. (×130.)

SUMMARY OF EXPERIMENTS

Number of dog	Date of operation	Date of death	Duration of post-operative life in days	Cause of death	Functional result	X-Rays: Days after operation	Gross specimen	Terminal condition of peg
1	10-16-20	10-23-20	7	Infection	Negative		Severe infection (not saved)	Engaged.
2	10-25-20	10-25-20		Ether				
3	11-8-20	11-10-20	2	Shock (?)				
4	11-12-20	11-16-20	4	Infection (?) Dog was burned		3	Infection (not saved)	
5	11-19-20	12-2-20	13	Infection	Negative	4	Superficial wound healed cleanly, but site of fracture bathed in pus. No union	Engaged.
6	11-26-20	1-3-21	38	Killed by ether. Superficial infection	Poor	3	Superficial infection caused by cast so severe that dog was killed by ether. There was no bony union. Peg embedded in distal fragment, and freely movable in proximal. Fibrous false joint	Engaged.
7	12-3-20	12-3-20		Shock				
8	12-10-20	2-7-21	58	Pneumonia	Negative: Cast still on at death	5	Firm fibrous union at angle of 45 degrees. Peg disengaged from upper fragment and resting against it. Callus formation, fibrous capsule. Slight amount of motion	Disengaged.
9	12-20-20	12-20-20		Ether				
10	12-24-20	1-19-21	26	Infection	Negative: Cast still on at death	6	Skin broken down and suppurating. No union at site of fracture. Bone peg loosely engaged in the two bone ends, the marrow cavities of which show some erosion	Engaged.
11	12-30-20	3-23-21	83	Infection of chest wall	Foot drop: No union	4	Dog died of infection of the chest wall. Wound clean. Peg firmly united to one fragment but disengaged from the other. Firm fibrous union. Muscular and fibrous attachment to the bone peg	Disengaged.
12	1-7-21	2-24-22	413	Killed by ether	Dog very active: Humerus angulated to 45 degrees	3, 127, 284, 377	Large amount of callus. Pegs disengaged. Firm union at 45 degrees	Disengaged.
13	1-14-21	1-19-21	5	Infection		3	Wound infected. No union	Disengaged (?).
14	1-28-21	2-24-22	392	Killed by ether	Excellent	7, 106, 263, 354	Peg had been disengaged, but there has occurred a firm union with some angulation	Disengaged.
15	2-4-21	1-12-22	338	Killed in dog fight	Poor	3, 254	Pus cavity at ends of bone. No union. Sequestra	Disengaged or broken.
16	2-11-21	3-6-21	23	Unknown	Negative: Cast still on at death	7	Wound clean. Transplant broken with extensive overriding of fragments. Firm, fibrous union	Broken.
17	2-25-21	3-5-21	8	Infection		5	Wound badly infected, and fracture lying in a lake of pus. The bone peg still held the two ends of the fractured bone in alignment	Engaged.
18	3-4-21	3-4-21		Ether				
19	3-18-21	12-13-21	270	Killed in dog fight	Unable to use leg 3 mos. after operation	4, 214	Fragments have become disengaged	Disengaged.
20	3-25-21	4-7-21	13	Infection			Wound badly infected. Peg broken in half at site of fracture. No union between pegs and medullary cavity	Broken.
21	4-1-21	4-8-21	7	Infection			Wound wide open and infected. Fragments wide apart	Disengaged.
22	4-15-21	2-10-22	301	Killed by ether	Walks with a limp	186, 278	Peg not definitely recognized macroscopically. A false joint with fibrous union	Disengaged (?).
23	5-13-21	5-13-21		Shock				

Number of dog	Date of operation	Date of death	Duration of post-operative life in days	Cause of death	Functional result	X-Rays: Days after operation	Gross specimen	Terminal condition of peg
24	5-13-21	5-27-21	14	Unknown (no infection)		1	Peg was disengaged. No infection	Disengaged.
25	5-20-21	2-17-22	273	Killed by ether	Limps	15, 211	Irregular union at about 60 degrees	Disengaged (?).
26	5-27-21	2-10-22	259	Killed by ether	Limps	144, 204	No remnant of peg visible macroscopically. A false joint with fibrous union	Disengaged (?).
27	6-10-21	6-14-21	4	Unknown Infection not evident			No infection	
28	10-14-21	2-17-22	126	Killed by ether	Uses leg well	5, 97	Peg broken	Broken.
29	10-21-21	10-30-21	9	Unknown			No infection. Peg broken off	Broken.
30	11-18-21	1-23-22	66	Infection		62	Infection. Disengaged	Disengaged.
31	12-9-21	2-17-22	70	Unknown		41	Considerable callus formation. Identification of peg difficult in the X-ray	Disengaged (?).

junction of the beef-bone peg with the live bone were carefully removed. These sections were decalcified, sectioned, and stained. A special study was made of the material from Dog 12, which was killed 413 days after the operation. The material was typical of that found in the other sections.

Dr. D. J. Davis, head of the Pathological Department of the University of Illinois Medical School, was good enough to confirm the following observations:

1. The live bone was everywhere in *very* intimate and firm contact with the dead bone (peg).

2. The dead bone was invaded and replaced by the live bone. This process was evidenced by the following:

a. Owing to the disintegration of the dead bone, its border was made up of a series of irregular bays or depressions into which tongues of the live bone protruded.

b. In the receding shores of the dead bone were noted new blood vessels branching out from the live bone. These vessels were noted to contain blood. Such vessels were not observed in the central areas of the dead bone.

c. The borders of the dead bone contained numerous bone corpuscles which were manifestly alive, while the central areas of the dead bone contained no such corpuscles.

d. Around many of the live bone corpuscles found in the borders of the dead bone were circular areas of new live bone. This indicated that new bone was not only formed by invasion and replacement of the old, but by the deposition of new bone around the new blood vessels found in the borders of the dead bone.

e. It seems most probable, from the appearances of the sections, that the new blood vessels have invaded the haversian canals of the dead bone.

3. The microscopic sections confirmed the observations made of the gross specimens, viz., that the pegs gradually melt away and are replaced by new bone.

4. There was no evidence that the presence of the dead bone stimulated the growth of pathological tissue of any kind.

SUMMARY

The study of these experiments has brought out the following conclusions:

1. That the part of the boiled beef-bone peg which remains in aseptic stable contact with the endosteum of its host, surrounded by living bone, becomes solidly embedded in new bone. The peg undergoes gradual absorption

and is replaced by new living bone which, later, in turn, is absorbed.

2. That part of the beef bone which lies between the fragments, but not protected by endosteum and not covered by living bone, even with aseptic surroundings, undergoes rapid absorption and disintegration and is not replaced by new living bone.

3. When one end of the beef-bone peg is not fixed in stable contact with the endosteum, but remains in position, there is absorption of both the peg and the surrounding live bone.

4. The internal callus, when the mechanical fixation holds and is aseptic, is limited by the beef-bone peg and does not bridge the line of fracture. The external callus is markedly lessened. The permanent or definitive callus is inhibited.

5. This series of experiments did not produce a single successful anatomical and functional result.

6. The causes of failure were:

a. Infection. Infections were very frequent and usually fatal.

b. Disengagement of the peg, due to:

1. Failure in the mechanical reduction,
2. Lack of continued immobilization,
3. Loosening of the repair by absorption of the peg and surrounding live bone.

c. Disintegration of the peg from absorption at the line of fracture. A repair, apparently mechanically perfect, would show a good result as long as the peg remained strong enough to sustain the bone. When disintegration of the peg occurred at the line of fracture, a point of mobility would be found.

The end-results were either permanent nonunion or lateral union usually in malposition.

DEPARTMENT OF TECHNIQUE

THE MANAGEMENT OF CICATRICIAL (BENIGN) STRICTURES OF THE ŒSOPHAGUS[1]

By PORTER P. VINSON, M.D., Rochester, Minnesota
Section on Medicine, The Mayo Clinic

ETIOLOGY

CICATRICIAL strictures of the œsophagus may result from any inflammatory reaction in or around that organ. The most common cause of these benign strictures, however, is the accidental or suicidal ingestion of a solution of household lye, which, even in exceedingly small quantities and very greatly diluted, often produces enough ulceration in the œsophagus to result in a cicatricial stricture (Fig. 1). Children are more often affected with this type of stricture, but it is also commonly seen in adult life. Many of the adults, however, have received a burn from the caustic in childhood, and do not develop marked dysphagia until later in life.

Benign strictures may also follow the swallowing of strong acids, or the long retention of a foreign body in the œsophagus, and have also resulted from the vomiting of pregnancy in nine patients observed in the Clinic. Ulceration in the œsophagus, with resulting stricture, may occur during the course of typhoid fever. Mediastinitis secondary to pneumonia, a suppurative appendix, or other infections, may involve the œsophageal wall to such a degree that the healing processes produce stricture. A few cases of œsophageal stricture have occurred during the course of scarlet fever, two having been observed in the Clinic.

A considerable number of cicatricial strictures of the œsophagus occur without any evident cause. The majority of these are probably secondary to an unrecognized low grade peri-œsophagitis. Simple acute œsophagitis with superficial ulceration only rarely results in the formation of strictures.

DIAGNOSIS

The diagnosis of benign strictures of the œsophagus is, of course, not difficult in cases in which there is a definite history of previous trauma in the œsophagus, but in those without such a history the differential diagnosis may be more difficult. Malignant stricture is practically the only lesion that may cause confusion, but the symptoms of dysphagia with this type of obstruction are usually of shorter duration than is the case with benign stricture. Roentgenographic examination and a careful œsophagoscopy will ordinarily settle the diagnosis. Syphilis and tuberculosis of the œsophagus occur very rarely, and may be disregarded for practical consideration.

TREATMENT

The treatment of benign œsophageal strictures consists of mechanical dilatation with graduated sounds, using a previously swallowed silk thread as a guide (Figs. 2 and 3). Under ordinary conditions, the thread is started 24 hours previous to the time of the dilatation and is cut off and allowed to pass through the intestinal tract after the dilatation has been carried out. Five yards of buttonhole twist, size D, is swallowed during a period of 24 hours, care being taken that the thread enters the stomach very gradually. If swallowed too rapidly, the thread will snarl and not permit the free passage of the dilating olives. At the end of 24 hours, the thread will have passed far enough into the stomach and intestines to permit of its being pulled perfectly taut without relaxation. By means of this simple guide, sounds can be safely passed through the stricture. Failure to swallow the thread is almost always due to lack of faith in the method, on the part of the physician, or patient. The thread will pass through the stricture whenever an opening exists. Perseverance is often necessary, but is always rewarded by greatly increased safety in instrumentation. (Fig. 4).

In very young children, it is occasionally necessary to put a catheter through the nose and to force the thread through this into the stomach by means of a syringe and small amounts of water. It is seldom necessary to resort to gastrostomy in these cases, but when it has been performed previously, the thread is swallowed in the usual way and, becoming entangled on the gastrostomy tube, can be brought out through the abdominal fistula. A heavy bass line is then tied to the lighter thread

[1] Read before the Twelfth District Medical Society, Hillsboro, Texas, July 11, 1923.

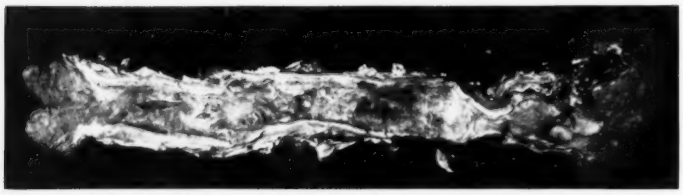


Fig. 1. Specimen of the œsophagus showing cicatricial stricture due to swallowing of lye. The patient died from pellagra. Note the sacculation in the lower third of the œsophagus. An attempt to pass an unguided dilator might lead to fatal results in such a case.

and pulled through the gastrostomy opening. Dilatations can then be accomplished by pulling sounds into the stomach. The bass line is left in the œsophagus constantly, but should be renewed frequently as it deteriorates rather rapidly. Whenever much difficulty is encountered in getting a thread through the stricture, it should not be cut off at each dilatation, but a heavy silk thread should be tied to the smaller one, and can be kept in the œsophagus for months at a time. A small

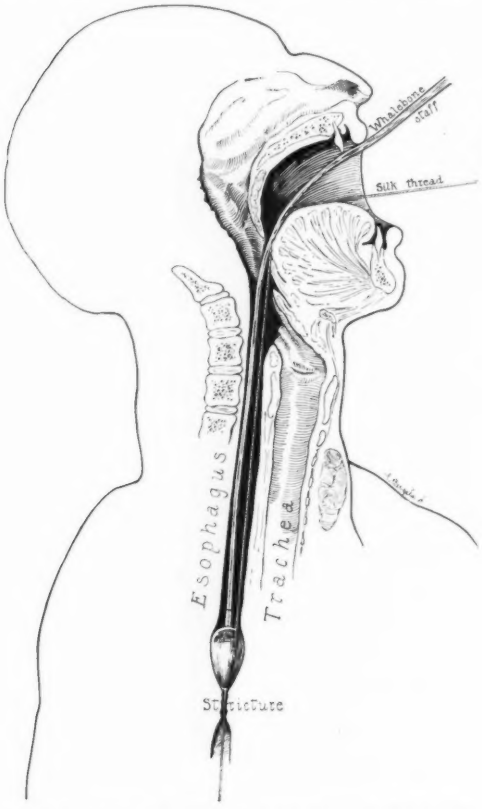


Fig. 2. Method of measuring the distance of the stricture from the incisor teeth.

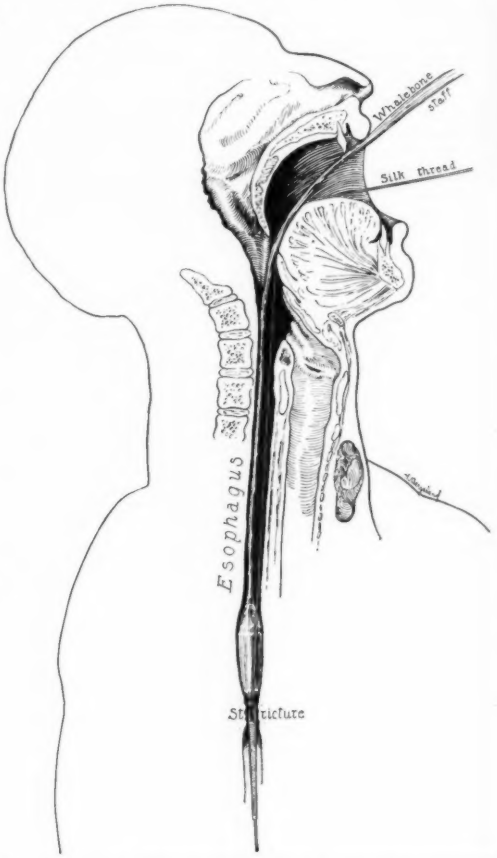


Fig. 3. Dilating sound guided on a previously swallowed silk thread.

Fig. 4. A child, aged nineteen months, with stricture of the œsophagus resulting from ingestion of a solution of lye. No difficulty was experienced in swallowing the silk thread.

amount is swallowed each day, and a portion must be cut off at every movement of the bowels.

In cases in which lye has been swallowed, the ordinary antidotes and supportive measures should first be employed, after which the patient should swallow a thread as soon as possible. Dilatations should not be carried out until dysphagia exists to a considerable degree, usually 6 or 8 weeks after the accident. The dilatations should be very gradual, and not more than one or two sounds passed at each stretching. The time between dilatations should be lengthened as rapidly as possible. It may be necessary to repeat them once a week for 3 or 4 weeks, after which the interval can be increased to 10 days, and then to 2 weeks. Finally, it becomes unnecessary to pass sounds more than once or twice a year. A sound should be passed at least once a year for 2 or 3 years, even though there has been complete freedom from dysphagia. Cicatricial strictures from other causes are treated in essentially the same manner as those caused by ingesting lye.

Most strictures can be dilated to 30 F. at the time of the first stretching, and almost all of them can be dilated to 45 F. within the first year. The sounds are increased by one or two sizes at each

Fig. 5. Piano wire passed through a stiff metal leader to be used for dilating cicatricial strictures when difficulty is experienced in swallowing the thread.

dilatation, depending on the ease with which the stricture can be stretched. Excessive trauma should be avoided as this simply increases the inflammatory reaction and prolongs the period necessary for treatment. Very dense resistant strictures are encountered at times, and it may be necessary to cut the stricture by a modification of the method originally devised by Abbe. Complete closure of a benign stricture may be caused by lodgement of a foreign body, and whenever this occurs the foreign body should be removed by œsophagoscopy. If the condition of the patient does not warrant the delay occasioned by the swallowing of the thread, a small piano wire with a tiny brass ball on the end may be passed through the stricture into the stomach, and the first dilatation can be given, using the wire as a guide (Fig. 5). This procedure is seldom employed as it entails more risk than when the thread is used in the usual way. Complete stenosis of the œsophagus should not be allowed to occur, but if it does the condition is practically hopeless so far as restoration of the lumen of the œsophagus is concerned. Anæsthesia should rarely be used when dilating any type of œsophageal stricture.

RESULTS OF TREATMENT

The results obtained from the treatment of benign œsophageal stricture by the methods described have been quite satisfactory. Complete and permanent relief from dysphagia is always obtainable if dilatations can be carried out for long periods of time. This frequently necessitates training the patient, or some member of the family, to make the dilatations, but with the simple thread technique this is usually accomplished easily.

It has been necessary to perform gastrostomy in only two cases of benign stricture at the Mayo Clinic during the past 6 years. In one of these, there had been a previous perforation into the left bronchus from blind instrumentation.

There is very little risk in dilating a benign stricture of the œsophagus if the sound is passed on a thread.

One hundred twenty-four patients suffering from benign œsophageal stricture have been

treated in the Clinic since January, 1917, and there have been six deaths following instrumentation. The patients have averaged about ten dilatations each while under our care.

None of our patients has developed malignant degeneration in the scar tissue, and in only one of our patients with carcinoma of the œsophagus was there a history of a previous benign stricture.

CONCLUSIONS

1. The majority of cicatricial strictures of the œsophagus are caused by the ingestion of solutions of household lye.
2. Practically all cicatricial strictures of the œsophagus can be cured by dilating with graduated olives.
3. The dilatations can best be effected by using a previously swallowed silk thread as a guide.
4. Gastrostomy is seldom necessary, and involves a definite risk in treatment.
5. Malignant degeneration in a cicatricial stricture of the œsophagus is rarely encountered.

CYSTOGRAMS: THEIR CLINICAL APPLICATION AND POSSIBLE MISINTERPRETATION

By HERMON C. BUMPUS, Jr., M.D., Rochester, Minnesota
Section on Urology, Mayo Clinic

WITH the accurate interpretation of pyelograms, a differential functional test, and a catheterized specimen of urine from the ureter, the diagnosis of a pathological condition of the kidneys is seldom doubtful. The cystogram, however, has not proved to be of equal value, possibly because the interior of the bladder is more readily brought under observation, and more accurately interpreted through the cystoscope than from a roentgenographic plate. Yet the cystogram serves as a valuable adjunct to the cystoscope and, if the possibility of its misinterpretation is appreciated, may give information obtainable in no other way. I shall direct attention here to some of the more common of these sources of error and present the types of cases in which cystograms are of the greatest aid in diagnosis.

Diverticula of the bladder. The cystogram reveals not only the position of the sac, but also its capacity, and if an additional plate is made after the bladder has been emptied, it will reveal whether the diverticulum also empties or acts as a receptacle for residual urine. If there are multiple diverticula, those that may have been overlooked, due to the inconspicuousness of their openings in a markedly trabeculated bladder, are revealed. The diverticula that empty, and are, therefore, non-surgical, are differentiated from those that return their fluid and must be resected.

False diverticula. A possible error in connection with the interpretation of cystograms is to mistake for a large diverticulum a portion of a greatly relaxed bladder that has been compressed in the center by extravesical pressure. Such error in diagnosis occurs because the shadow cast by the dome is projected by the rays in a position which appears independent of the main part of the bladder and gives the impression of a diverticulum nearly equal in size to the bladder (Fig. 1). This is most likely to occur in cases of prostatic obstruction, in which the relaxation of the dome is the most characteristic deformity, and if rayed from a certain angle will appear, not as an extension of the bladder, but as an independent diverticulum. A diverticulum located in the base of the bladder so that the shadow of the bladder completely obliterates the diverticulum is also misleading, but incorrect interpretation may be avoided if the proper technique in exposing the plates is followed (Fig. 2) or if a lead catheter is coiled in the diverticulum (Figs. 3 and 4).

Urethral diverticula. Urethral diverticula are often a puzzling problem to the cystoscopist, for while the opening is readily noted, it may be impossible to detect the depth of the sac and its extension. If such a diverticulum is filled with an opaque fluid of a different density from that used to fill the bladder, a contrast roentgenogram, showing the anatomical position of the urethral diverticulum will be obtained.

Tumors of the bladder. Malignant growths in the bladder are usually discovered by the cystoscope, but because of bleeding, secondary infection, intolerance, or position, it may be difficult to determine their exact extent. In such cases a cystogram will usually show, by the filling defect present (Fig. 5), whether the growth is resectable, or must be treated by palliative measures, such

Fig. 1.

Fig. 2.

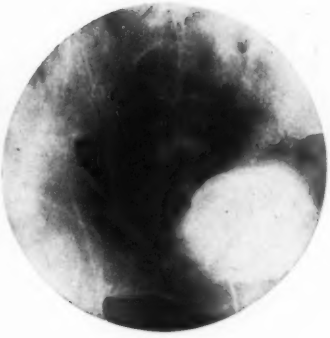


Fig. 3.

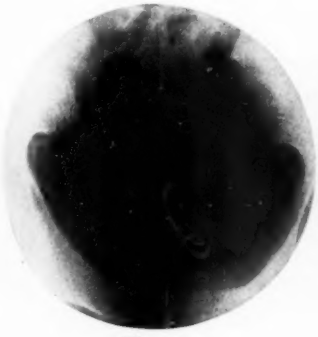


Fig. 4.

Fig. 5.

Fig. 6.

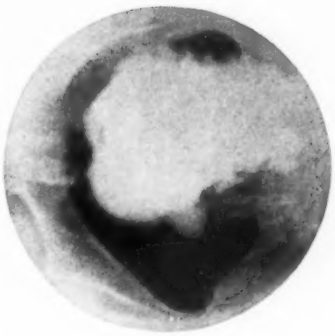


Fig. 7.

Fig. 1. A false diverticulum produced by the compression of the center of the bladder and the shadow of the dome being projected over that of the bladder itself. (Case A431199.)

Fig. 2. A large diverticulum, the shadow of which is thrown clear of the bladder by tilting the roentgen tube well to one side of the pelvis. This diverticulum might have appeared as part of the bladder if the picture had been taken directly from above. (Case A260528.)

Fig. 3. Shadow of bladder completely obscures diverticulum containing lead catheter shown in Figure 4. (Case A317953.)

Fig. 4. Lead catheter coiled in a diverticulum that was obscured by the shadow of the bladder in Figure 3. (Case A317953.)

Fig. 5. Tumor of the bladder. Extent of infiltration in the wall of the bladder which demonstrates its inoperability. (Case A304029.)

Fig. 6. Filling defect resulting from blood clots associated with tumor of the bladder, giving an erroneous idea of the extent of the tumor. (Case A436500.)

Fig. 7. Elevation of the base of the bladder and marked trabeculation and relaxation of musculature, the result of prostatic hypertrophy. (Case A436267.)

as roentgen-ray or radium. In this connection care must be taken to exclude blood clots as a cause of filling defects (Fig. 6), for if the tumor bleeds freely sufficient clots may form to produce a filling defect that will give an entirely erroneous impression of the extent of the malignancy.

Prostatic hypertrophy. If a diagnosis of prostatic hypertrophy has been made by rectal palpation and confirmed by the finding of residual urine, there is usually no necessity for cystoscopic examination, which results mainly in the detection of coincident diverticula, or stones; the presence of stones will usually be demonstrated by the roentgenogram (Fig. 7). A routine cystogram will demonstrate the presence of diverticula and of residual urine, which may have escaped

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 8. Normal cystogram without elevation of the base of the bladder, obtained from patient with prostatic hypertrophy. Hypertrophy not demonstrated by cystograms. (Case A341296.)

Fig. 9. Cystogram showing advanced bilateral pyelonephritis that has resulted in marked dilatation of both ureters with an associated reflux to pelves of the kidney. (Case A248002.)

Fig. 10. Cystogram revealing reflux up single ureter with marked trabeculation of the bladder in a case of lesion of the spinal cord resulting in atony of the urinary tract. (Case A259589.)

detection when the first test was made. If, however, the patient gives a definite history of prostatic disease, and rectal palpation fails to show an enlargement of the gland in proportion to the symptoms, a cystogram will not afford reliable information concerning the intravesical enlargement of the prostate. Often cystograms in cases of considerable intravesical enlargement show no elevation or filling defect of the base (Fig. 8), while patients with but slight intravesical enlargement show considerable elevation, due probably to distention of the lower bowel by gas or fæces.

Ureteral reflux. The knowledge that urine from the bladder passes up the ureters to the kidneys is often of great clinical importance, and this is most readily demonstrated by a cystogram taken in the Trendelenburg position. Such reflux often occurs in patients suffering with bilateral pyelonephritis (Fig. 9), and lavage of the renal pelvis may be easily accomplished simply by filling the bladder with the lavage solution desired, and elevating the patient's buttocks. Such lavage eliminates the necessity for cystoscopic examination and ureteral catheterization, which is a great relief to the patient. Instead of washing the renal pelves once or twice a week, as would be the case if a cystoscope were used, it is done as often as desired, with much better ultimate results. In the most advanced cases it is, of course, possible to detect with the cystoscope the urine from the bladder as it regurgitates up the ureter, but in the earlier cases the apparently normal ureteral meatus is often incompetent, and if routine cystograms are taken in cases of pyelonephritis the reflux will be discovered. In 114 such cystograms the reflux was noted in twenty-one.

Diseases of the central nervous system. In cases of disease of the central nervous system reflux often occurs, and is easily overlooked if cystograms are not made. Of seventy patients with disease of the central nervous system who were examined by the cystogram, seven had a reflux of the cystographic medium up the ureters. Usually the reflux is on both sides, but in some instances the atonic condition of the urinary tract is on one side (Fig. 10) and the removal to the diseased side results favorably. As in cases in which the dilatation of the ureter is due to infection, so in these cases in which it is due to loss of tone, the result of nerve injury, the ureteral orifices may not indicate their incompetency. It is, therefore, important to make routine cystograms when trabeculation of the bladder, or relaxation of the sphincter indicates a central nervous system lesion.

Congenital anomalies. In the diagnosis of congenital anomalies of the urinary tract the cystogram is most useful, since often there is dilatation of the entire urinary tract, especially in cases in which there is some form of obstruction in the posterior urethra, a condition which occurs in children (Fig. 11).

Renal tuberculosis. In cases of unilateral renal tuberculosis that have resulted in a rather exten-

Fig. 11.

Fig. 12.

Fig. 11 (at left). Reflux up an enormously dilated ureter in a case of congenital stricture of the urethra in a child. (Case A348044.)

Fig. 12. Reflux up the ureter of the normal kidney in a case of unilateral renal tuberculosis and tuberculous cystitis, the result of the production of the so-called golf hole meatus. (Case A303068.)

sive tuberculous cystitis, the urine from the bladder flows up the ureter of the unaffected kidney, while the strictured ureter on the diseased side usually prevents the flow upward (Fig. 12).

In a series of sixteen cystograms in cases of urinary tuberculosis, reflux occurred in seven, in five of which it was up the unaffected side, in the remaining two up both sides.

TECHNIQUE

In making cystograms the bladder should be filled with one of the usual pyelographic mediums. Sodium bromide 16 per cent, or potassium iodide 12 per cent, may be used; they are both inexpensive and easily prepared. The potassium iodide seems preferable, as at 12 per cent it is isotonic and casts a good shadow. These salt solutions, however, have a slight irritating effect, and if patients have considerable cystitis, silver iodide emulsion 5 per cent is more satisfactory because of its mechanical qualities. It also casts a denser shadow and is very soothing to the inflamed mucosa. After the bladder is filled the urethra should be compressed with a penis clamp or tight bandage, and the first picture taken directly above the symphysis, so that the outline of the bladder will be thrown clear of the sacrum. Two other pictures should then be taken with the roentgen tube tilted so that the first picture is projected to the right, the second to the left. By such means diverticula that are near the base of the bladder and might be obscured by the shadow of the bladder in pictures taken directly from above, are thrown so that their shadows fall along the periphery of the bladder and thus are brought into view (Fig. 2). The fourth plate is taken like the first, the bladder having been emptied either by voiding, or by a catheter; this plate will disclose diverticula that do not drain, and, also, if the bladder first has been emptied by voiding, will reveal the amount of residual urine that is present.

THE SKATE IN FRACTURES OF THE LOWER EXTREMITY

By R. M. YERGASON, M.D., Hartford, Connecticut
Orthopedic Surgeon, St. Francis Hospital

THERE are many fundamental principles and prime essentials in the treatment of fractures of the lower extremity. One of these, always to be considered, is the proper position in which the foot is to be placed and maintained.

When plaster of Paris is employed to maintain the fragments, the foot is usually incorporated in the plaster and no difficulties are encountered. With the use of suspension methods and open metal splints, however, the foot becomes a real problem. Especially difficult are those cases of compound, comminuted fracture involving the lower third of the tibia and fibula in which traction becomes necessary in conjunction with carefully adjusted foot position.

The heel pin and Finochietto stirrup have been employed for such cases, always with the danger of a new point of infection, with side slipping of the pin, and chance of cutting out on the part of the stirrup. The Sinclair skate was a move in the right direction but, like a hand lens, it is not adapted to fine adjustment for meeting the varying requirements.

Mothered by this necessity, a skate has been developed gradually, which has proved satisfactory in every way at the St. Francis hospital. It is described in the hope that it may be equally effective in the hands of others.

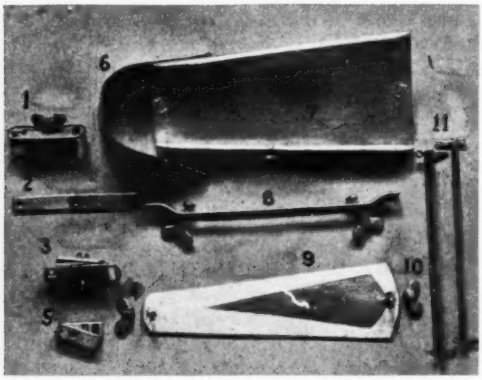


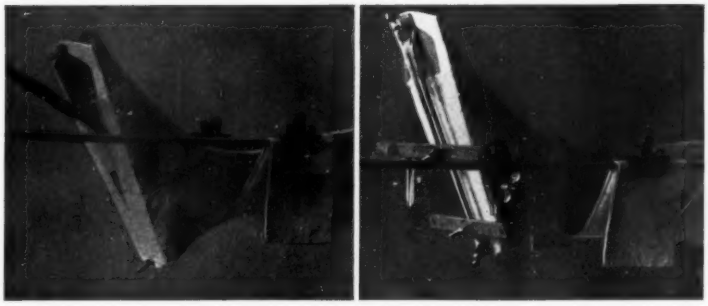
Fig. 1. Parts of skate: *1*, Clamp; *2*, traction crossbar; *3*, clamp; *4*, wing nut; *5*, center clamp for round crossbar; *6*, heel cup; *7*, sole pan; *8*, long slot bar with two bolts; *9*, sole plate covered with adhesive plaster ready for attachment to foot; *10*, crossbars—one round, one flat with cotter pin; *11*, wing nut.

In the presence of a severe compound, comminuted fracture of both bones of the leg near the ankle, with the emergency clean-up operation done, the operator places the leg in a Thomas, or similar, splint and returns the patient to bed. Here it is desired to control absolutely the position of the foot and to maintain traction without conflicting in any way with the dressings and cleanliness of the wounds. To accomplish this the skate is applied as follows:

There are two different sole plates, or pans, provided for the skate (Fig. 1, *7*). Of these the smaller one, which is slightly concave from side to side, is selected. The concave surface is first covered smoothly with adhesive plaster as this is the side which is to rest against the foot. If desired the plate may be padded with felt to conform to the arches of the foot but, as the tendency of the skate under traction is to increase the height of the arches, this has been found unnecessary. Ten or twelve pieces of 2-inch gauze bandage are cut about 10 inches long and a few shorter and a few slightly longer ones as well.

The sole of the foot with as much of the heel and instep as possible are exposed and the plate of the skate is held in position with its concave surface against the sole of the foot, the narrow end at the heel and even with it, the wide end extending above the toes. One of the pieces of gauze bandage is placed smoothly about the skate pan and foot so that its ends lie across one another smoothly upon the instep. This is carefully glued to the foot *and plate* by means of celluloid[1] applied with a small, rather stiff, brush. Before this has dried, a second strip of bandage is placed, partially lapping on the first, and pasted down (Fig. 2). The gauze strips are thus used, one after another, about the foot, ankle, and heel, up to the very edge of the wound, if necessary, until three or four layers have been applied. Care must be exercised, throughout, to have the gauze lie perfectly smooth, with no wrinkles or irregularities, and to see that every mesh is thoroughly filled with celluloid and no air bubbles are allowed to

[1] The celluloid solution is prepared as follows: Fill a one-pint, wide-mouthed bottle half full of acetone. Add half a dozen strips of celluloid, about four inches by one inch in size, and shake. In a few hours solution will be effected. This amount is sufficient for two or three applications. Exact proportion of celluloid is of no consequence but the liquid should be fairly thick. A common cork is the best stopper for the bottle and on setting it aside invert the bottle for a moment so that the solution will seal the cork on the inside and thus minimize evaporation. The preparation should be kept on hand as it takes time to prepare. Use a long-handled, half-inch, rather stiff paint brush to apply the solution and place a paper under the foot to catch the drippings.



Figs. 2 and 3. Application of skate.

remain. The whole dries in a few minutes so that the skate becomes an integral part of the foot itself. The other parts of the skate, which steady the foot and control its position, may now be attached.[1]

The small bolts, projecting from the plate attached to the foot, slip through holes in the ends of a flat steel bar which is then made fast by adjusting small wing-nuts upon the bolts at heel and toe (Fig. 3). This flat bar has a long slot carrying in it two small, loose bolts with wing nuts. The upper one of these bolts, that nearer the toes, serves for the attachment of the supporting crossbar which rests upon the side bars of the splint (see illustrations).

There are two of these supporting crossbars with the skate, one flat with a slot at the middle and the other a round rod, both being furnished with cotter pins in small holes at the ends. Of these bars the flat one is intended for use when the foot is to be kept rigidly fixed (Figs. 3 and 7); and the round one is used for mobility in traction or for active motion at the ankle (Figs. 4, 5, and 6).

In the case of the fracture under consideration the round crossbar is the one of choice. To attach it to the skate a small clamp is provided which will grip the middle of the round rod between its jaws. The jaws furnish two grips, or bites, in one of which the round bar is held tightly, in the other loosely. The clamp is pierced by a hole which allows it to be bolted to the skate (Figs. 4, 5, and 6).

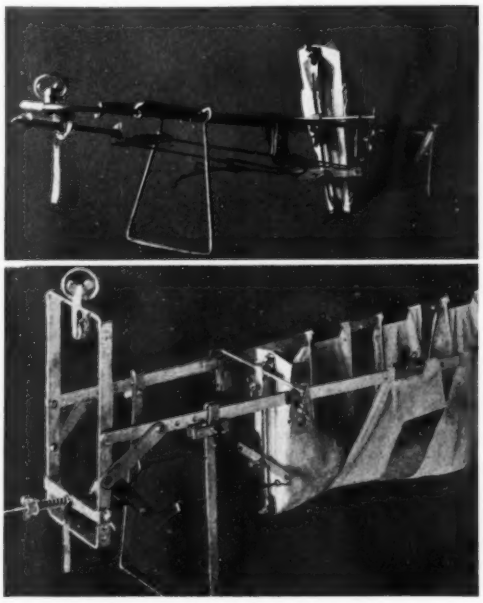
When the cross rod has been clamped to the skate with its ends resting upon the side bars of the splint the rotation of the foot with respect to the leg is under control and also its position anteroposteriorly in relation to the splint.

The short crossbar should, next, be attached to the as yet unused bolt in the long slotted bar of the skate. This short bar should be placed at a point horizontally in line with the malleoli and the wing nut tightened. It is to the ends of this bar that the traction is attached.

Traction is next applied either by tractor, as illustrated, which is convenient and effective,[2] or

[1] In place of the strips of gauze bandage a white sock may be used. The sole plate is first put in the sock, holes being cut at toe and heel for the bolts to pass through. The pulling necessary to put on the sock may be painful to the patient; if so, the sock should be slit down the front, in which case it is not much better than the gauze strips. It is much harder to fill the meshes of a sock with the celluloid and get firm adhesion than it is with gauze. In the case of an elderly woman with comminuted fracture of the femur and very tender skin the writer employed a stocking extending above the knee. The whole stocking was glued on with celluloid and was perfectly well tolerated, under traction, for over 3 weeks. It was only necessary to cut a hole in the stocking over the external malleolus where slight skin irritation appeared.

[2] Yergason, R. M. A screw tractor for use with Thomas' splint. J. Am. M. Ass., 1920 lxxiv, 886.



Figs. 4 and 5. Skate applied for extension.

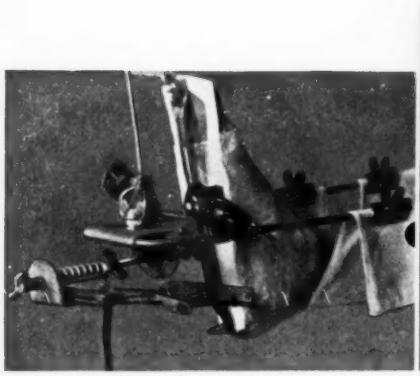


Fig. 6.

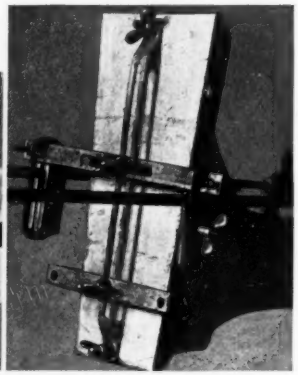


Fig. 7.

Fig. 6 (left). The clamp plates may be adjusted so that their slots are oblique instead of horizontal.

Fig. 7. A second sole pan with detachable heel cup for use in maintaining dorsal flexion without traction applied to foot itself.

by attaching the traction crossbar of the skate by a cord directly to the end of the splint, or by means of weight and pulley. The amount of traction, of course, should be sufficient entirely to overcome the muscles and any overriding of fragments. A common error is too weak a pull which is fostered by the adhesive plaster method of attaching traction to the leg. With the skate as a part of the foot the full force of the pull is applied to advantage and there is no loss due to slipping plaster, skin and muscles which always occurs when adhesive plaster is used.

When the traction has been adjusted the side clamps of the skate can be attached. There are two of these, their purpose being to fasten the supporting crossbar of the skate to the side bars of the splint.

Each clamp consists of a bolt, with wing nut, upon which are strung four loose members. Two of these members are grooved near one end and serve as the jaws for gripping the side bar of the splint. They are separated by a third member or key which enables them to grasp round rods of varying sizes and also to keep them apart and parallel should they be required to grip a splint the side bar of which is flat (Fig. 5). The fourth member on the bolt is a thin flat plate having rounded corners, a short slot where the bolt passes through and, near its ends, several other perforations in some one of which the end of the crossbar of the skate will be retained. The T-shaped opening at one end of the plate will take the end of the flat crossbar of the skate. At the other end of the plate is a comparatively long transverse opening which would be the one of choice for the round crossbar.

To apply one of the clamps the jaws are first arranged opposite each other with the key evenly between them on the side away from the bite. These are held in this position with one hand while the other hand adjusts the thin plate over the end of the crossbar from which the cotter pin has been temporarily removed. The jaws of the clamp are next separated enough to grip the side bar of the splint and the wing nut is tightened, thus locking the clamp. The other clamp is then placed in a similar manner (see illustrations).

With the ends of the round crossbar in the slot-like openings of the clamps the foot is allowed considerable play, but by altering the position of the clamps on the splint and by adjusting the plates of the clamps at the proper angles any undesirable movement of the foot may be prevented. Play of the crossbar in the clamps is necessary under traction and, as the traction crossbar is always posterior to (heelward of) the supporting crossbar, the tendency of the pull is to force the foot toward dorsal flexion, the crossbar in the clamp plates acting as a fulcrum. Should this tendency toward dorsal flexion be undesirable, the clamps may be set slightly further down the splint (distal) so that the crossbar rides in the upper (proximal) ends of the slots. So arranged, the traction can move the whole foot down until the crossbar has traversed the length of the slots which, if the pull is sufficient, will be accomplished in twenty-four hours when the clamps may be moved down the splint again and made to hold the increase

in length thus obtained. Moreover, the clamp plates may be adjusted so that their slots are oblique instead of horizontal (Fig. 6) producing a tendency for the crossbar to slide down the incline displacing the foot in the direction of traction. If, due to tipping of the whole splint and consequent sliding of the supporting crossbar, a tendency is noticed for the foot to move bodily sidewise, the crossbar should be set over in the direction of this tendency as far as it will go, i. e., until the cotter pin bears against the clamp plate on the high side. The cotter pin prevents the end of the crossbar from slipping out of the clamp.

The position of the foot is now entirely under control. Its position anteroposteriorly and laterally in the splint, and its internal or external rotation are controlled by the central bolt of the supporting crossbar. Pronation or supination can be obtained by setting one of the side clamps further up the splint than the other, thus placing the skate and foot in an oblique position in the splint. The amount of dorsal flexion can be increased by setting the traction crossbar nearer the heel so that the ankle joint becomes the fulcrum.

In some cases it is necessary to hold the foot perfectly still in a certain position and, in such cases, the flat crossbar of the skate should be used. With this, positions of dorsal or plantar flexion are provided for by inclination of the clamp plates (Fig. 3). With either crossbar any position or combination of positions can be obtained.

A second sole plate, or pan, with a detachable heel cup is furnished with the skate. This is for use when it is desired simply to maintain dorsal flexion without traction applied to the foot itself (Figs. 1 and 7). This sole plate is convenient when traction is applied by means of adhesive plaster stickers. Here again the flat crossbar maintains steady position and the round one allows active motion at the ankle.

SUMMARY

Maintainance of the foot in proper position is a problem invariably present in fractures of the lower extremity.

With compound, comminuted fractures near the ankle and open splint methods of treatment the problem is particularly difficult.

To meet the varying requirements of different cases, splints and traction methods, a skate has been devised and its use here described.

The skate properly attached to the foot with celluloid allows leaverage as well as traction to be applied with all the effectiveness and none of the dangers of the heel pin or the Finochietto stirrup.

The skate will hold the foot in any position or combination of positions, with or without motion, with none or with any method of traction desired and in splints the side bars of which are either round or flat.

It is hoped that the skate will prove as valuable to others as it has to the writer.

VARIOUS METHODS OF "FINISHING" A PLASTER-OF-PARIS CAST[1]

By PHILIP LEWIN, M.D., Chicago
Attending Orthopedic Surgeon, Cook County Hospital; Junior Attending Orthopedic Surgeon, St. Luke's Hospital; Assistant Professor of Orthopedic Surgery, Northwestern University Medical School

ALTHOUGH the inside of a plaster-of-Paris cast is of the greatest importance, this paper deals with various methods of "finishing" a cast. It is a point in plaster-of-Paris technique.

A brief summary of the best known methods in general use follows:

1. *Calot's method.* A heavy layer of thick plaster cream is carefully smoothed as a plasterer builds a wall. The final result is accomplished by delicately going over the cast with a large piece of wet cotton. Having had a special course under Dr. Calot, the writer can testify to the beauty of his casts.

Comment: Often the outer layers crack, especially near the edges.

2. A wet plaster bandage used as a "rubber" or "ironer."

3. A hard rubber roller similar to the roller used by wall paperers to obliterate over-lapping edges.

4. Dusting on plaster powder like talcum powder, and rubbing it in.

5. Dusting on talcum powder and rubbing it in.

6. Two coats of shellac or varnish on a dry cast. This is especially valuable in spica casts in small children who soil them.

7. Celluloid dissolved in acetone as a thin cream painted on a thoroughly dry cast.

8. Stockinet covering of entire cast. This is expensive and takes considerable time on the part of the nurse.

9. Tacking the stockinet, using small tacks which rust into the plaster.

In 1919, while engaged in postgraduate work at the University of Paris, my attention was directed by Dr. B. W. Moffat, of Red Bank, New Jersey, to the following method of finishing a cast. It was demonstrated to us by Professor August Broca's plaster nurse at Hôpital des Enfants Malades. She learned it from an orderly many years previously. The method consists in applying a single sheet of dry crinoline to the cast and rubbing it in. When I returned to America in July, 1919, I modified the routine slightly as out-

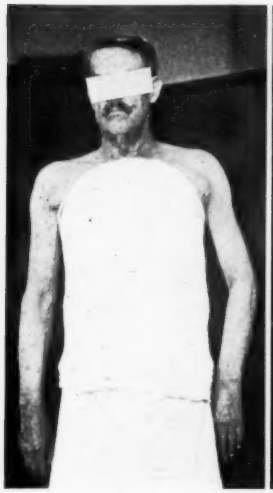


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Figs. 1 and 2. Unfinished plaster cast.
Figs. 3 and 4. Illustrating the complete envelopment of the cast in stockinet. One double length piece of the material may be used for this purpose. (A sheet is wound around the patient's thighs and secured by an elastic webbing band.)

[1] From the Orthopedic Department of St. Luke's Hospital.

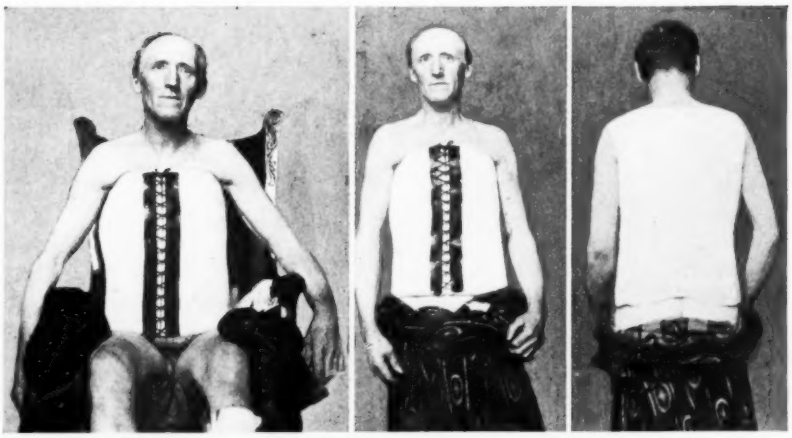


Fig. 5. A removable plaster-of-Paris jacket applied to a case of multiple fractures of lumbar transverse processes, 5 weeks after accident. When the cast is dry and trimmed to comfort, it is cut down the front, removed, and bandaged. The brace maker applies the steels, leather, and lacings.

lined below and have used it in several hundred casts with gratifying results.

TECHNIQUE

1. The last plaster bandage must be creamy.
2. Quickly apply a sheet of dry crinoline and rub in thoroughly especially the edges which must not be curled over or under.
3. When the plaster is about to set, use a rolled up strip of wet plaster bandage as a shoe shiner. If the last bandage is not creamy, make up in a small bowl some thin plaster cream and impregnate the crinoline with the plaster and apply. If any windows are to be cut out, "plaster ropes" may be used to outline them and reinforce the edges before the final dry crinoline layer is applied.

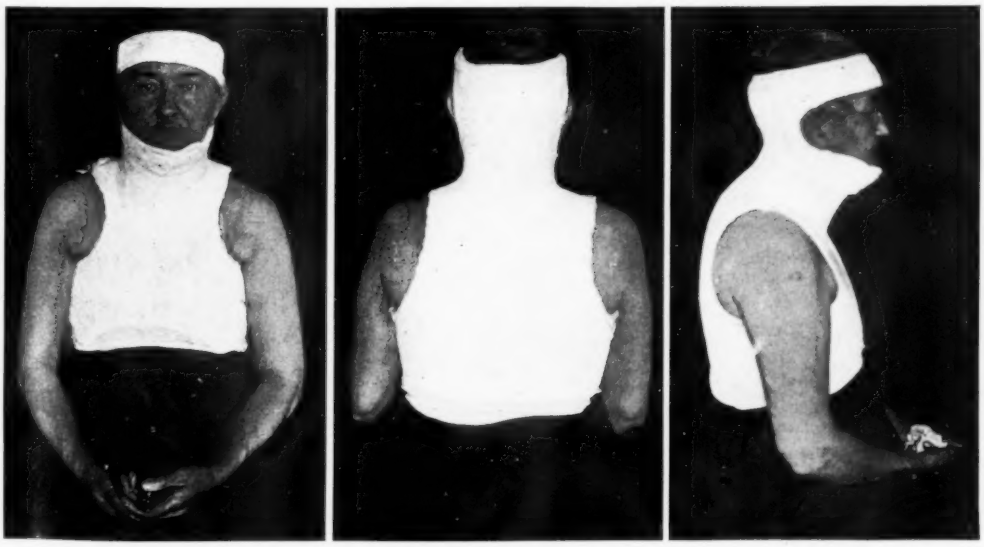


Fig. 6. Illustrating the type of cast indicated in cervical or upper dorsal tuberculosis, osteoarthritis, or injury.

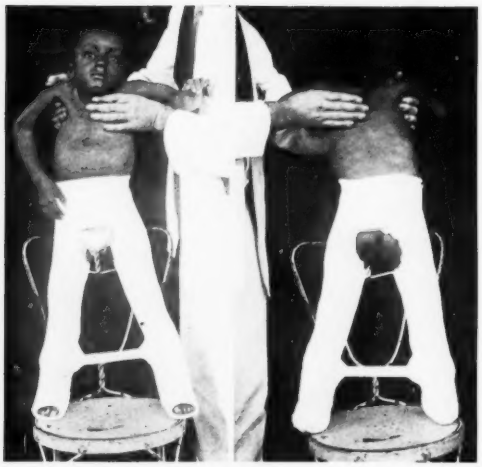


Fig. 7. Double spica cast with cross bar which is of great aid in handling the child. He is raised by placing one hand behind the neck and the other on the cross bar. Cast applied to a case of osteogenesis imperfecta with five operative fractures produced by osteoclasis manuelle 10 days previous to taking this photograph.

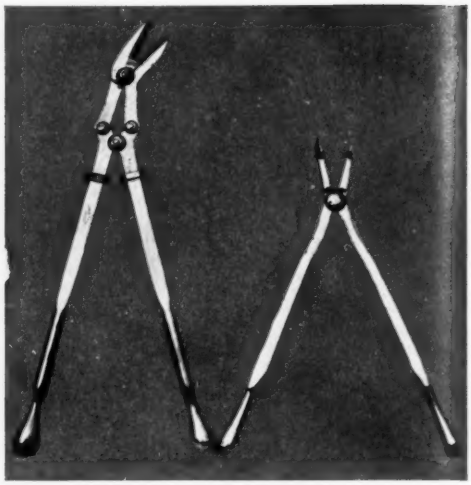


Fig. 10. Plaster cutter and plaster spreader.

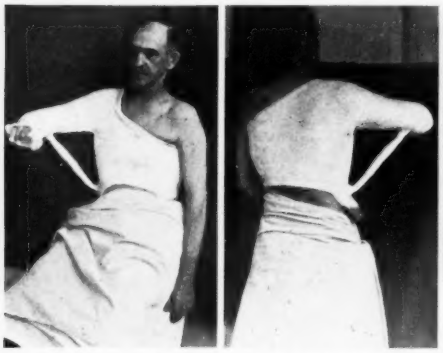


Fig. 8. Illustrating a spica of the right shoulder used in maintaining abduction. (No external rotation was indicated in this case.)

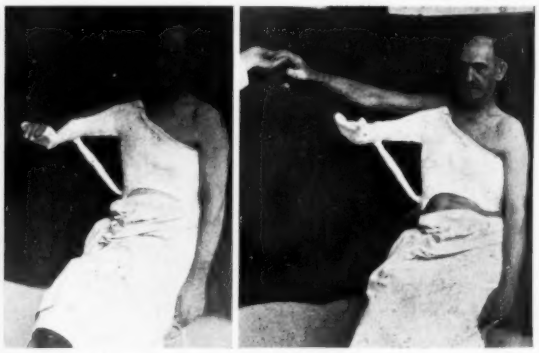


Fig. 9. Same cast as in Figure 8 made into a shelf splint preventing adduction but permitting abduction.

The advantages of this method are: (a) It adds one layer of strength. (b) It never cracks as Calot's might. (c) It keeps the patient on the table or frame from 2 to 3 minutes longer, thereby minimizing the danger of cracking the cast, especially in a spica of the hip. (d) It encourages rubbing the plaster cast so as to make one homogeneous mass of it instead of a series of layers like an onion.

The date in indelible pencil should be marked on every plaster cast. An outline should be made with indelible pencil, of windows to be cut out such as in scoliosis jackets, over operative wounds, over abscesses, etc.

The author desires to thank Dr. J. L. Porter, several of whose patients are shown in these illustrations.

THE SMALL DEEP GRAFT[1]

Experiences and Results of the Last Three Years

By OCTAVE CHARLES CASSEGRAIN, A.M., M.D., New Orleans
Department of Surgery, Tulane University of Louisiana School of Medicine

SKIN grafting furnishes one of the most romantic pages in the history of surgery; not because of the difficulties the early surgeons had to overcome, for that is the story of all medical achievement; but because in no other field of medicine, perhaps, did the imagination of the physician have such play.

From the earliest times, surgeons realized the need of covering large areas denuded of skin, and in their perplexity tried every available material from parts of the amniotic sac, to the lining membrane of eggs and the skin of animals, such as sheep, frogs, and dogs. Success followed in one or two instances, but successive trials repeatedly ended in failure.

It was only with the coming of the autograft that skin grafting may be said to have been a successful procedure. And to Reverdin, who in 1869 introduced his pin graft and Ollier and Thiersch, who independently in 1886 introduced the graft which bears their name, must go the credit for placing skin grafting on a practical working basis. Today with the exception of the few cases where skin is removed from donors whose blood is of the same group as the recipient, all skin grafts are taken from the patient himself.

Up to the fall of 1920, skin grafting was to me a very distasteful operation, necessary at times, it is true, but done always with a feeling of pessimism as to results, which was all too often justified. About that time, however, John Staige Davis described a graft which he called the small deep graft and we decided to experiment with it. Our first attempt was so successful that we were encouraged to try again. Since that time we have used it with much success in almost all our cases of denuded skin areas where the larger flap operations were not indicated and in three instances in conjunction with the flap operations; and I have come to look forward with pleasure to an opportunity of performing this operation.

We have used the small deep graft chiefly to hasten healing following the radical removal of tumors for malignancy, in extensive burns, and in the various types of traumatic wounds of the extremities that are admitted to our service at Charity Hospital. We believe that it is preferable to graft granulating surfaces rather than fresh raw surfaces, because in the former, vascularization takes place more quickly. We prepare the receiving surface in the following way:

The morning before the operation the area to be grafted is cleansed and an alcohol dressing applied; on the morning of the operation it is thoroughly bathed with warm saline solution. Scraping or shaving of the surface with curette or scalpel is absolutely contra-indicated, for if the surface bleeds, efforts to control the ooze by hot saline compresses devitalize the surface and often result in failure. If the surface appears nonsucculent or fibrotic it is permissible, I might better say advisable, to rub it gently with gauze moistened with warm normal saline.

The small deep graft is essentially a whole thickness graft and unlike the Reverdin, which is an epidermic graft, includes all the layers of the skin down to the subcutaneous fat. The area from which the grafts are removed, resembles small pits, and fat is always seen at the bottom of the pit, showing the depth to which we cut to obtain the graft. The diameter of the graft varies in size from that of a lead pencil eraser to that of a dime, but the diameter of the ideal graft should be half way between the two. The simplicity of obtaining the graft is one of its recommendations, though not the chief. There is no need here of a sharp razor, of a perfectly steady hand skilled in barely shaving the top of the papillæ; there is no tedious uncurling of the rolled up edges of the graft; but instead, a long Keith needle and ordinary scalpel are used. The needle is passed through the skin which is elevated in the form of a cone, the base of which is then cut through with the scalpel and placed on the raw surface to be covered.

Children and highly timorous persons excepted, all skin grafting should be done under local analgesia, but we have found that infiltration of the skin to be transplanted devitalizes it to a variable degree. For this reason we have developed the following technique: After preparing the donor skin by first scrubbing with alcohol, we map out a rectangular area, usually on one of the thighs, and infiltrate the skin and loose connective tissue along the proximal and two lateral sides. This gives us a central area anæsthetized, but uninfil-

[1] Read before the Orleans Parish Medical Society, May 14, 1923.

trated, from which we pick our grafts. The grafts are then placed on the receiving surface from one-fourth to one-sixth of an inch apart and then pressed into place with wet gauze and covered with five or six thicknesses of gauze dipped in normal saline. This first dressing is held in place by adhesive plaster to prevent any shifting of the gauze which might dislodge the grafts before they have become adherent. Plain dry gauze is then added and the dressing completed with a roller bandage. The dressing is undisturbed for 4 days and removed on the morning of the fifth day. In removing the dressing there is but one precaution to observe, but it is a very vital one. The dressing should be first thoroughly soaked with alcohol or normal saline and removed in layers, until only one last strip of gauze is left over the grafted surface. This last strip can then be removed with impunity. Unless that precaution is observed, some of the grafts, even though they have taken, will of necessity become detached, due to the caking and stiffness of the dressing to which they adhere and from which they have not been separated by this gradual removal of the dressing. After the dressing is entirely removed a thin layer of epidermis can be seen branching out from the edges of the grafts and filling the space between them, and frequently the whole grafted surface is covered by a coagulated serous ooze which might easily be mistaken for thin pus.

The surface is cleaned with alcohol, dried and covered with adhesive plaster. Adhesive plaster is used for its stimulating and conductive properties. The wound is dressed daily or every other day, adhesive plaster and dry gauze being used alternately until epithelization is completed. After 7 days, unless there is a contra-indication, we have the patient take a warm bath daily for its stimulating effect on epidermization.

In the cases reported below, the grafting was not all done by myself, but every man on the service, including two of our internes, operated on at least one patient.

Our best and quickest results, as might well be expected, were obtained in grafting granulating surfaces following the wide excision of malignant tumors; for here, we dealt with tissues undevitalized by trauma and infection. Our next best results were in the treatment of burns and ulcers. In those types of cases we did not have a single complete failure and all but one case were absolutely satisfactory.

In our male service we used the small deep graft on eight patients. Three of the patients had had extensive crushing and lacerating injuries, and débridement was done on admission. Their average stay in the hospital was 2 months. Their average stay after grafting was 28 days. The shortest stay was 11 days, the longest, 60. In two of the cases the grafting had to be done twice, for all of the grafts did not take. These two patients, however, had suffered horrible mutilations and in neither case did we lose all our grafts. In our other cases, three osteomyelitis, and one sarcoma of the thigh, the grafts were satisfactory, and the patients were discharged in from 17 to 25 days from the time of grafting. Our only complete failure was in a boy 7 years old, who had suffered an evulsion of the heel and plantar surface of the foot. The flap was sutured in place in the Accident Room, but sloughed a few days later. Three attempts to cover the heel were made. Two Wolf-Kraus grafts failed, and the third and last attempt with the small deep graft was also unsuccessful.

In our female service all but three of our eleven cases were grafted following radical breast amputation and in these the average number of days that elapsed from the day of grafting to the day of discharge was 14 days; the smallest being six, and the greatest twenty-nine. One patient who had forty-five small deep grafts, all nearly as large as a dime, placed on a large granulating surface, the result of an extensive breast amputation, was discharged 11 days after operation, healed.

In the case of the woman who remained 29 days, an overzealous interne, mistaking the normal wound secretion of which I spoke previously for infection, dressed the grafted surface with dichloramine-T. Two days elapsed before we discovered the mistake. Much to our astonishment, however, every graft was in place and had resisted the corrosive action of the drug, but the surface was bleeding, angry looking, and all the fine sprouts of epidermis had, of course, been destroyed.

Of our three other cases two were grafted for burns and one for luetic ulcer. The ulcer was grafted on June 18 and epidermization was complete on the 30th, that is, in 12 days. Our burn case was grafted on June 2 and epidermization was complete on the 14th. The third case I will not report as Ollier-Thiersch grafts were used.

CONCLUSIONS

In conclusion, therefore, we wish to state that we have found:

1. That the small deep graft is by far the easiest type of graft to obtain.

2. That it is the most viable, as evidenced by our experience in the case where the dichloramine-T was used.

3. That being a whole thickness graft it is not only firmer and more resistant than the epithelial graft, but is especially useful in the grafting of exposed localities, such as the heel or shoulder where on account of pressure a thin graft will not stand the strain.

4. That even in the cases where all the grafts did not take, there was undoubtedly a distinct stimulating influence exerted on the granulating surface which hastened its complete epidermization.

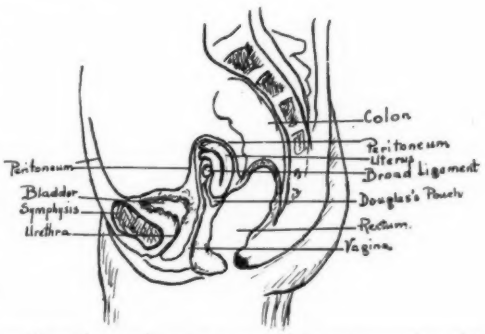
In closing, I wish to thank Dr. H. B. Gessner, our chief of staff, for granting us the use of the material from his wards.

AN OPERATION FOR THE CORRECTION OF PROCIDENTIA OR MARKED CYSTOCELE AND RECTOCELE

By NORMAN D. MORGAN, M.D., San Francisco
Gynecologist, Mary's Help Hospital

THE following operation is a very simple method of correcting a common disorder known as prolapse of the uterus or procidentia and is especially adapted to patients who have passed the menopause.

After making necessary repairs of the cervix and perineum, the abdomen is opened with a suprapubic, median incision. The ovaries and tubes are inspected and dealt with in the usual manner. The intestines are blocked with laparotomy sponges. The tubes and ligaments are separated from the uterus as is done in performing hysterectomy. The bladder then is dissected back and the peritoneum on the posterior wall of the vagina is dissected off down to the bottom of the cul-de-sac. The uterus is freed from all its moorings except inferiorly where it is still attached to the superior vagina. The uterus is held anteriorly while the two free ends of the round ligaments are sewed together behind the uterus, but the uterus is still left free. The ligaments must be sewed in such a way that they will form a firm, tight ridge behind the uterus. The uterus is pulled up, thus taking up the slack in the vaginal walls, and with a long piece of chromic gut on curved needle in a long holder a good substantial "bite" is taken in the fascia at the bottom of the cul-de-sac between the freed peritoneum and the posterior vaginal wall, and another "bite" is taken in the fundus of the uterus. When the suture is tightened the fundus of the uterus will be attached to the cul-de-sac fascia, the uterus thus



undergoing as it were a complete retroversion riding upon the connected round ligaments as its fulcrum. In doing this the vaginal walls are pulled up tightly because the uterus is here used as a lever against a strong and firm fulcrum (the connected round ligaments). The peritoneum is now sewed over the uterus to the peritoneum of the bladder as in hysterectomy. In extreme cases it may be necessary to do a supravaginal hysterectomy and use the stump of the cervix left to be drawn down into the cul-de-sac over the round ligaments, thus giving tighter vaginal walls. It is necessary that the round ligaments be fairly strong and firm and do not hang too low in the pelvic cavity.

I have performed this operation in several cases, and it has given in all of them most gratifying and satisfactory results.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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APRIL, 1924

MEDICAL JOURNALS IN THE ENGLISH LANGUAGE

IN May, 1923, the *Lancet* celebrated its centenary. It is a matter of just pride to the medical profession of the world that the *Lancet* has diffused medical knowledge to the English-speaking public for four generations. Since the establishment of the journal by Thomas Wakley in 1823, its policies have been directed by a member of the Wakley family. The fearless policy of the *Lancet* has, for a century, aided the members of the regular medical profession in England in maintaining a high scientific position, free from fads and quackeries.

In America, the *Journal of the American Medical Association* is a source of pride and satisfaction to the medical profession. It can be said truthfully that this is the greatest medical journal in the world, and that it supplies the largest organized body of medical men in the world with information on medical topics. The American Medical Association is inseparable from the *Journal*, and the *Journal* in turn is inseparable from its editor, Dr. George H. Simmons, who, in his dissemination of so-called graduate medical literature, has done more for the medical profession of the United States as a whole than any other man of his time.

Of the many other valuable medical journals of high character and wide scope, including those devoted to special fields, I shall allude only to four that are notable in surgery.

The *Annals of Surgery* was the first journal devoted to surgery, published in America. From its early years it has been edited by a man who is not only a master of the English language, but is also a surgeon of wide experience. We are thankful that Dr. Lewis G. Pilcher has had the strength to maintain the editorship which has given him so distinguished a place in surgical literature.

In the last few years the merit of two new surgical journals, each appealing to surgeons of the highest intelligence, has gained recognition. The *British Journal of Surgery*, issued quarterly under the editorship of a committee of which Sir Berkeley Moynihan is chairman maintains a high scientific standard; this may be said also of the *Archives of Surgery*, edited by Dr. Dean Lewis, and published by the American Medical Association, for the purpose of advancing surgical science and stimulating research.

SURGERY, GYNECOLOGY AND OBSTETRICS, the official organ of the American College of Surgeons, the wide distribution of which is evidence of its popularity and excellence, is before you, and speaks for itself.

Graduation from medical college is but the commencement of the practice of medicine. For a few men it is the end of a professional life and the beginning of a trade, but the large majority of the members of the medical

profession are hard working, intelligent, earnest men, anxious to give their patients the benefit of the latest scientific knowledge. In the process of the physician's education after graduation, clinical trips play an important part. These trips should be made for the purpose of investigating and studying the achievements of others. Time should not be consumed in the observation of inferior work. Attendance at medical meetings is helpful, because opportunities are afforded for the exchange of views, and for better understanding of the personalities of forceful men of the medical world who are contributing to progress.

Above all, familiarity with the contents of medical journals is essential. Every practitioner of medicine should charge himself with the obligation of devoting at least an hour a day to their study, and should pay the debt. If for any reason he misses a day or two he should make up the time, but if on any one day he is able to read for a number of hours, he should credit himself with only the single hour. The man who will follow this course will, almost unconsciously, become well informed in medical matters, and if he has the power to apply and correlate this knowledge with his own experience, he will become a leading member of the medical profession. Many men, in speaking of an original conception of a disease, an original method of treatment, or an original operation, have informed me that the idea came to them in the attempt to correlate their own experiences with those reported by writers of articles in medical journals.

To the physician, patients represent medicine in practice, books on medicine represent stabilized medical opinion, and medical journals, the very breath he breathes, represent medicine in the making.

W. J. Mayo.

THE TEACHING OF UNDERGRADUATES IN MEDICINE

During the past 30 years we have witnessed great changes in the method of teaching undergraduates. In fact, one might almost say it had been revolutionized. Sufficient time has now elapsed since the inauguration of these changes to estimate their value properly and those who should do this are those familiar with both the old and the new method. Perhaps it might be well in the beginning to grant that on the whole the present method is the better but in some particulars I think it is much inferior.

The object of the medical school has always been, and should continue to be, the turning out of men capable of giving to the sick the proper care and attention, in other words, the making of doctors. This should be our prime object. If perchance we should occasionally turn out a scientist or an embryo discoverer, so much the better, but it is a fatal mistake to try to make all our students research workers in the hope that one or two of each class may ultimately turn out to be a real scientist. All should have a thorough, general knowledge of the fundamental branches, especially anatomy, physiology, and pathology, and then they should be taught diagnosis and treatment. None will probably take exception to this formula, but an inspection or rather a questioning of recent graduates will show, I think, that it has hardly been adhered to in recent years. The men have been taught a few things very thoroughly, or have studied one phase of a subject very diligently, to the neglect of others equally necessary to the development of diagnostic ability and judgment. Let me illustrate, taking first anatomy. There was a time when a good knowledge of general anatomy was considered essential, when a student must have dissected every part of the human body, but this time

has apparently passed in many schools. In the English, Scotch, and French schools, the medical student is much better instructed in this important subject than in ours, where too often special work in one department of anatomy, such as embryology or histology, or the careful dissection and study of one part is taken as a substitute for a general working knowledge of the whole subject. Many recent graduates have told me that they had dissected only an arm or leg; others that they had never had any systematic instruction in general or topographical anatomy, and still others, a few, who said they had never seen their professor of anatomy and were supposed to gain their knowledge by reading and the contemplation of charts and dissected parts. Another very intelligent interne, finely trained along certain lines, told me he knew everything about a Colles' fracture, but not a thing about any other; that he had never seen any other nor had 5 minutes' instruction on the general subject of fractures. Should such a man, however brilliant, be given the degree of doctor of medicine and allowed to practice? I think not and yet it is no fault of his own but that of his teachers. Many other recent graduates have no knowledge of the diagnosis of fractures or of the methods of reduction, for the one they depend entirely on the X-rays, and for the other on open operation; a sad commentary indeed on their medical education, but I assure you it is no exaggeration.

We are teaching undergraduates what we should teach graduates. This change is noticeable usually in the third year of the medical course and sometimes it begins to make its appearance even before this. The latter is noticeable when a first or second year student is allowed to neglect his systematic studies and is given credit for work not done in these lines because he is doing special laboratory work under the direction of a head, or subhead, of a department. This work may be developmental and of great value to the student in later life, but *cannot* and *should not* take the place of systematic and thorough study of the fundamentals. Sometimes this special work of the student is of no value to him whatever, being simply the work that a *diener* might do, requiring no exercise of the knowledge the student has already acquired. Too often it is simply playing a minor and, as far as the student is concerned, a useless part in a piece of pathological research the professor is doing.

These observations, I think, show that some of the changes which have taken place in recent years do not represent advancement, but the contrary. One cause of these changes is the tendency in recent years to appoint men to the chairs in undergraduate schools because of the reputation they have gained as research workers or in some limited field of medical or surgical practice, regardless of their ability, and sometimes in spite of their inability, to teach. The professor in an undergraduate school should first of all be a teacher, if perchance he should also be deeply interested and engaged in research so much the better, but the inability or disinclination to impart to the students committed to his care the well established facts regarding the subject he is supposed to teach, while he and a few chosen students endeavor to discover new ones, should render him ineligible to a chair in an undergraduate school. It is no easy or agreeable occupation to go on year in, year out, teaching well known and established knowledge, but this is just the duty which a professor owes to his school and his students. To the real scientist this should not be distasteful, for he must realize that his students cannot reach the point of being able to do advanced and valuable research without this fundamental knowledge, which he himself took many years

to acquire. We need real pedagogues in our medical schools and we can do with less research conducted by the student to the neglect of those fundamental studies which must form the basis of all valuable advanced work. I believe that many students, who would ultimately do distinguished work in their profession, either as scientists or practitioners, have their careers spoiled, or at least handicapped, by the lack of a thorough general knowledge of anatomy, physiology, chemistry, and pathology. The medical schools have turned out too many men highly trained along certain limited lines who are grossly ignorant of the principles of medicine and surgery. And it is hard, pretty nearly impossible, for those men to make up this loss and they go through their careers as narrow men instead of broad men. They are "hell on fits," but on "fits" only, with the world full of other ills demanding study and attention.

The professor of anatomy, who teaches only the phase of anatomy in which he is particularly interested, is comparable to the surgeon who spends his time teaching the technique of difficult and often unusual operations, when he should be drilling into his students surgical principles, familiarizing them with the clinical picture of surgical diseases and endeavoring to develop in them, to some extent at least, surgical judgment. The first plan may be the pleasanter but it does not cancel the professor's obligation, and it turns out on the world a lot of impractical automatons. The hardest thing to teach in any branch of medicine is the reasoning which is so essential to the successful diagnosis and treatment of disease, and yet this should be one of the prime objects of the teacher of undergraduates in medicine.

In our endeavor to do away with the old didactic method, which certainly has its faults, and substitute the bedside method of teaching, we must not lose sight of the fact that a large body of the class may fail entirely to receive instruction on important subjects. To teach only from the patients who happen to be in the wards or dispensaries is a great mistake and can never take the place of orderly systematic instruction. There cannot, however, be too much teaching with the patient and student both at hand.

I hope in trying to make clear certain points I have not indulged in exaggeration; and think I have not. If then you can agree with me you can readily see that unless we adhere to what is good in the old method and avoid what is bad in the new, we are sure to fail in what would seem to be our *raison d'être*, namely, the turning out of doctors to treat the sick.

There are some, however, who will disagree with much, if not all, I have said and to them I should reply that it is our failure to turn out practical doctors and enough of them to take care of our communities that has been a potent factor in the propagation of osteopaths, chiropractors, and other quacks.

The medical schools of the United States must graduate physicians who can and will treat the sick; not in the larger cities and medical centers only, but in the villages and hamlets and in the far away places of the earth. The time is coming when the public will demand of the medical school a production in proportion to its endowment.

A French surgeon, who recently visited the medical schools of America was surprised at the size and equipment of some of our schools, but when he learned of the number of students being taught he was astounded and said: "In France with such a plant and such an endowment we could teach thousands where you teach hundreds." An exaggeration, if you want, but food for thought.

JOHN H. GIBBON.

MASTER SURGEONS OF AMERICA

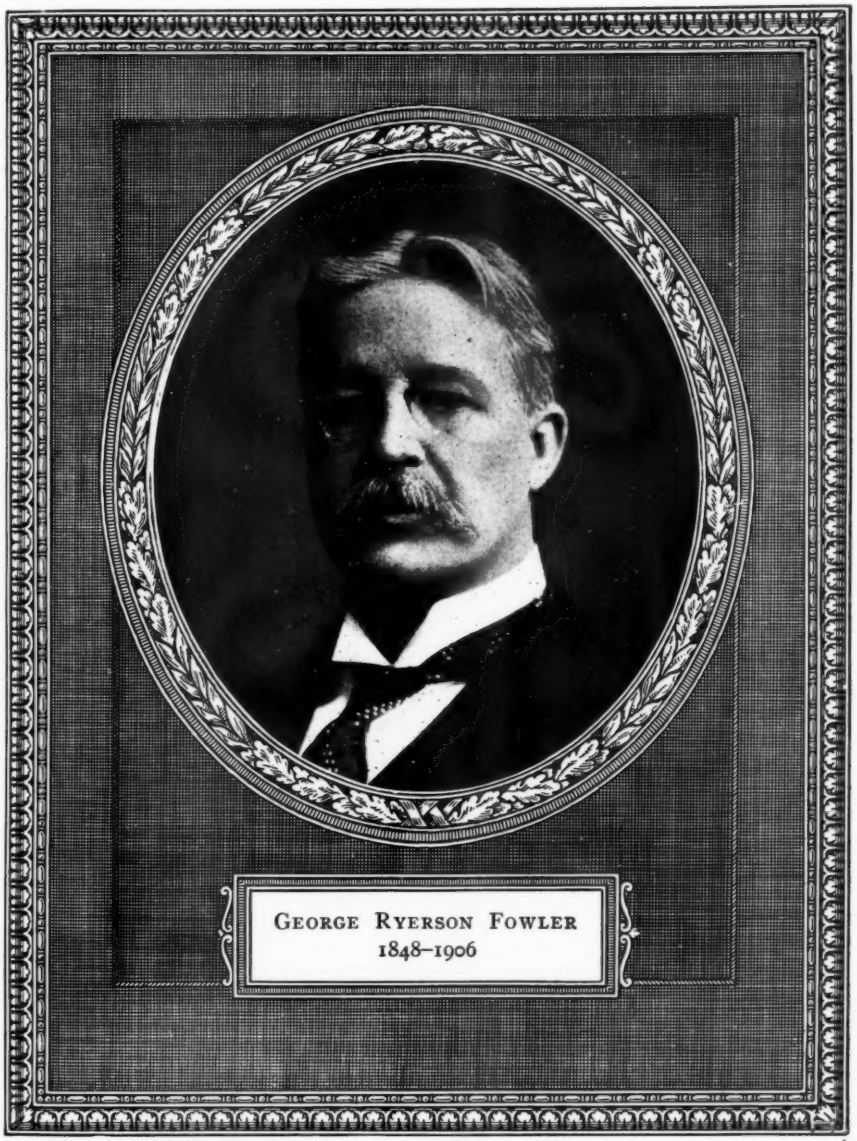
GEORGE RYERSON FOWLER

FOR twenty-five years previous to his lamented death in February, 1906, George Ryerson Fowler held the foremost place among the surgeons of Brooklyn, New York. In securing this place he had not been helped by any adventitious circumstance; it was the result of his own energy and capacity.

He was born in New York City, December 25, 1848, of parents who for several generations had transmitted the best traits of an English Colonial strain. Later his father, having been made the master mechanic in charge of the repair shops of the Long Island Railroad, removed to Jamaica, Long Island, where the shops were located. Here the young George grew up, and in the common school of the village was taught until he was old enough to enter as an apprentice the shop which his father superintended.

Meanwhile, the civil war broke out. George was fired with desire to have a part in it, and soon after its outbreak, being yet a boy of twelve years of age, ran away to seek a recruiting station in the City. A police alarm discovered him and he was brought back to his parents in the custody of a policeman and was persuaded to defer his military aspirations. He always retained a penchant for military affairs and in later years ran the whole gamut of the National Guard of his State, from a regimental assistant surgeon to surgeon, brigade surgeon and surgeon general. The Spanish American War found him at the height of his professional activities, but he did not hesitate to throw everything aside and put on the uniform of his Country's Army. He was commissioned a chief surgeon of division and was assigned to duty as medical inspector, consulting surgeon, and chief of the operating staff of the Seventh Army Corps, in which capacity he served throughout the war.

That the apprentice boy, working at the bench in a railway repair shop should develop into a great surgeon was due—so Fowler himself used to say—to an accident in the shop when he was called on to assist in the care of the sufferers. The surgical instinct was then awakened in him. As it grew it was fostered and directed especially by two men who took an interest in him, one a pharmacist and the other a former army surgeon. The open, frank, and enthusiastic nature of the boy, which enlisted the help of these men in realizing his ambition, caused him in after years, when he had boys of his own, to show his grateful appreciation



GEORGE RYERSON FOWLER
1848–1906

of what these early friends did for him by bestowing upon these boys the names of these earlier friends! Doubtless this experience of the shop accident called forth the peculiar instinct of the young apprentice, but the soil must have been ready for the seed—Nature's gift of the qualities that manhood was to develop and ripen.

The path from the shop to the benches of the medical school was an easy one sixty years ago. Three years of study including two courses of lectures at a medical school sufficed to earn a degree. Of course, then as now, such a training could only have introduced a man into the vestibule of medical knowledge. It opened the door, it pointed the way, the later progress depending upon the inherent qualities of the neophyte himself. Fowler made the most of his opportunities; he was thoroughly in earnest; he had a mind quick to apprehend, thirsty for knowledge, and a natural mechanical aptitude that turned him especially to those things in which the hand could actively engage to accomplish an end: he was a born chirurgeon, indefatigable in the dissecting room, and devoted to the clinic. He did not attempt to secure an hospital interneship because he could not afford to put off for a year or more the beginning of the time when he could earn money to pay his debts as well as to secure his daily bread. In 1871 he was graduated as a Doctor in Medicine from the Bellevue Hospital Medical College, and at once opened his office in Brooklyn in a location that promised an immediate demand for his services.

It was in the crowded tenements of the poor that he found the experience that took the place of hospital wards. For fifteen years thereafter he carried on a constantly enlarging general practice, in which, however, the surgical element became increasingly prominent. He had no hospital connection, no teaching position, no influential coterie of friends to push his fortunes. It was purely the force of his own personality that made his career possible. He began his work just as the Listerian teachings were coming to be appreciated by the surgical world. Fowler accepted the doctrines of antisepsis with enthusiasm and led in their advocacy despite the critical skepticism of the older surgeons who had hitherto controlled the surgical situation in the community. He wanted to teach, he wanted the opportunities of a hospital ward, he constantly felt the urge of the surgical spirit that was in him. The avenues to such positions in all the existing institutions were preempted by others. At last the opening of a new hospital brought to him the desired opportunity, when, in 1883, he was appointed one of the surgeons to the recently opened St. Mary's Hospital. Four years later, when the Seney Methodist Episcopal Hospital was opened, he was appointed one of its two attending surgeons. Later when the staff of the Brooklyn Hospital was re-organized he was made its chief surgeon, and somewhat later still upon the organization of the German Hospital the first surgical appointment on its staff was given to him. By 1890 he was in the full tide of his surgical activities. Un-

tiring, full of enthusiasm, delighting in his work, he was passing from hospital to hospital. He was not only an untiring worker but he was equally untiring as a student. He read, he wrote, he traveled, he mingled with men, he steadily grew in mental breadth and in professional capacity, while his natural aptitude and his manual skill remained the dominating elements in his special work. He was elected to membership in the New York and in the American surgical societies. He attended the International Medical Congresses at Moscow and at Paris. When in 1890 the State of New York instituted a State Board of Medical Examiners, he was appointed one of its organizers, and the chair of surgery was assigned to him, a position which he continued to hold throughout the remainder of his life.

Fowler's contributions to surgical literature were frequent. Although he was continually doing an amount of work that would exhaust the endurance of a half dozen ordinary men, he never seemed to be tired, and after a full days' work in office, ward, and operating room, would settle down to writing in his library until the early morning hours. When he did retire an emergency call that would rouse him from his bed would be responded to by him with the readiness and eagerness of a recent graduate. The number and variety of his papers on surgical subjects testify to his industry and to the scope of his labors. While his writings dealt with all regions of the body, it is probable that his name will long be associated especially in thoracic surgery with the subject of the decortication of a lung in chronic empyema, and in abdominal surgery with the early operative treatment of appendicitis; and with the semi-sitting position in the treatment of general peritonitis the "Fowler position."

Among the pioneer workers in appendicitis he was most earnest in advocating early and radical surgical interference. His work on the subject, published in 1894, will remain as a valuable landmark in the history of the evolution of the surgery of the appendix.

For many years he labored in the preparation of a systematic treatise on surgery, to the writing of which he devoted hours that he stole from the tale of those that should have been devoted to sleep. It was published in 1906. The last proof sheets were corrected by his own hand, but he did not live to see a printed copy of the book over which he had labored so assiduously through the years. In February, 1906, while en route to attend a meeting of the State Medical Examining Board in Albany he was seized with intense abdominal pain; on arrival he was carried to the hospital. His colleagues operated with all promptness for the removal of a gangrenous appendix; he lingered for a few days; a paresis of the ileum developed which was obstinate to all efforts for its relief, and on the sixth day of February in the beginning of his fifty-sixth year, his great heart stood still. In the completion of his book he had evidently completed his life's work. His book is the epitome of his life—into every page of it he infused his own personality. It

is valuable in itself. In its clearness of diction, comprehensiveness of treatment, and the practical directions for resort to surgical relief it is unsurpassed by any book of its day. It is still more valuable, however, as an example of the possibility of the achievements of ardor, enthusiasm, pluck, energy, and perseverance in wresting brilliant success out of conditions apparently forbidding and sterile.

George R. Fowler was of medium height, compactly built, with a frank attractive countenance, and a piercing eye. He was companionable and engaging in his relations with his fellows, always kindly and sympathetic in his attitude to those who sought his help. He had a breezy positive way about him that could not fail to awaken the confidence of those with whom he came in contact. He always carried his profession with him and loved to talk about any phase of it. He left an enduring impression upon the community in which he lived as well as upon the surgery which he loved. In the work of his pupils and of his sons who now occupy positions of responsibility in the surgical world he still lives.

LEWIS S. PILCHER.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD NOVEMBER 2, 1923, DR. ALLEN B. KANAVEL, PRESIDING

DR. CLARENCE W. HOPKINS read a paper entitled "Injuries and Anomalies of the Spine."

THE USE OF BOILED BEEF BONES AS INTRAMEDULLARY PEGS IN FRACTURES OF LONG BONES; AN EXPERIMENTAL STUDY

DR. CHARLES DAVISON AND DR. FREDERICK CHRISTOPHER contributed a joint paper on the use of boiled beef bones as intramedullary pegs in fractures of the long bones. (See page 534.)

DISCUSSION

DR. CHARLES DAVISON: Scattered throughout the literature are reports of cases of fractures treated by the boiled beef bone peg, but the end-results, as a rule, are not given. This led us to try to follow up the end results in some cases, but we were unable to follow them long enough to learn what the end-results would be. We undertook these experiments with open minds hoping to find something of value. I think many of the human cases reported were discharged while the beef bone pegs were intact and apparently a clinical cure obtained. From watching these dog experiments there is no question but what there is a period when an apparent cure of the fracture is present. The part of the beef bone peg which lies between the bone fragments, which is unprotected by periosteum or live bone, gradually absorbs until it spontaneously disintegrates or breaks through, allowing the fracture to become loose. Then it must go through a period of nonunion, possibly with displacement and union in a malposition. Our experiments condemn the use of boiled beef bone as a means of treatment of fractures in the human.

DR. M. L. HARRIS: In the treatment of fractures of the long bones, foreign bodies of whatsoever material filling the medullary cavity, as dowel pins or internal splints, are not desirable. Their introduction necessitates the destruction of a great deal of endosteum, which is of so much importance in the repair of these fractures. The detrimental effect of such foreign bodies on the healing of fractures has often been demonstrated experimentally.

DR. HARRY M. RICHTER: I am very much interested in the work done by Doctors Davison and Christopher. However, my results are so absolutely different from those obtained in their experiments on dogs that it seems to me the basis for this difference should be sought by workers in this field.

I have used beef bone and ox horn pegs as dowels in fractures in the human being with perfect clinical results. It seems to me that the bone peg functionates in a fracture as does catgut in the suturing of fascia. Its purpose is to hold the ends of the bone in contact. It may have a second purpose, namely, to hold the fragments in a straight line, but this is better attained by external supporting splints, the ends of the fragments being held in contact by the bone pegs. The function of the latter ceases when sufficient callus is formed to prevent slipping, provided the external splints are applied. It is rather desirable than otherwise that they should disappear early, for having performed their function, their continuance in position must be as a foreign body and useless if not harmful. In one of the X-ray plates shown by Dr. Christopher, that part of the bone peg which projected from the fragment showed absorption while that part within the fragment threw a darker shadow. My explanation of this phenomenon is quite different from that of Dr. Christopher's. I would suggest that that part of the bone peg which projected into the soft tissues was absorbed as is all tissue within a foreign element, while that part buried in the fragment was impregnated by the live bone of its environment. And it seemed to me that this proves that the bone dowel does not inhibit medullary growth and does not account for the inhibition of callus formation in the experimental work. That it does not inhibit callus formation is also proven by my own clinical results and by the work of others whose results have been at variance with those of the speaker.

DR. WILLIAM R. CUBBINS: To me it seems perfectly clear, that Doctors Davison and Christopher have demonstrated conclusively that there is no comparison between the use of live bone and dead bone in transplants. It is extremely interesting to see the great effort made by the young vital bone of the pup to grow into the boiled bone graft. In the older animals this does not occur.

I must take issue with Dr. Richter, that the boiled beef bone graft serves as well for a splint as living bone. And especially must I take issue with him upon the statement that it is only necessary to immobilize these fragments a short period of time. In two of my patients in which an intramedullary splint

of autogenous living bone was made, one a humerus and the other a femur, marked bowing occurred; in the femur, which was taken out of the cast 7 weeks following the implantation of the graft, a very marked lateral bowing occurred after that period; in the humerus, marked bowing occurred upon the removal of the splint 5 weeks after the implantation of the graft. These conditions occurred in spite of the fact that the graft lived and has since demonstrated that it is living and taking up the functions of the bone into which it was implanted.

Why it should take longer in some instances for these bones to stick together with an intramedullary bone graft it is not possible for me to state, but there does seem to be a slight inhibition in the production of firm callus in some of these cases. If that is true with living bone, it seems obvious to me that boiled beef bone would be far more likely to cause a serious disturbance, just as has been shown by Dr. Christopher.

Dr. C. C. Rogers: I would like to ask Dr. Davison why, when these bones were put together and dowels put in, there was no union? It seems to me, that with the proper preparation and the application of a cast, better results would be secured than if a bone peg were not used. Why is it that when put in apposition and a bone peg inserted, these bones do not unite as they would if the bone peg were not put in?

Dr. E. C. Riebel: With reference to the fractures Dr. Richter spoke of, I wish to say that Lexer has recently stated that there is a field for the use of bone pegs but this use is limited. He lays great stress on the fact that a reasonable time should elapse before operation for the development of a hyperæmia, as there is a fight between specific and non-specific tissue elements. If the specific elements get the upper hand, we get union, but if the non-specific elements predominate, we get non-union. Hence we should await the optimum time during which the specific bone elements have their greatest reparative force. As Dr. Richter stated, there is a certain time when these fragments will hold, that means, when the specific elements are in a state of full development; otherwise, connective or non-specific tissue elements will invade the bone, be it beef or living bone.

Dr. E. Wyllys Andrews: At the International Congress of Surgeons, held in London a year ago, the work of MacAusland, of Boston, was largely along the line of arthroplastics and transplants. The proteolytic elements produce absorption of these fragments where the condyles or other bones are transplanted. There is one thing we must do and that is to type individual animals or humans almost as carefully as we would do in cases of transfusion. There is scarcely any doubt that today a couple of dogs can be transfused one with the other back and forth until we get them completely typed, and then we can make a successful transplant of whole tissues as well as fascia. If there is any feature in the successful preservation of these grafts in the living, it is probably in the line of first preparing our patients, making them actual donors and recipients over quite a period of time.

Dr. Phillip Kreuscher: During the 7 years of my association with Dr. Murphy, it was part of my duty to look after the bone and joint cases postoperatively. As far as I know, only one beef bone was used as a medullary transplant; all the others were autogenous transplants placed into the medullary canal. In ordinary cases of non-union it is necessary to immobilize absolutely for a period of three or four times that required for normal union. If there is bone defect which must be spanned, then, of course, immobilization must be continued very much longer. I have under my care a case of fracture of the radius in which there was a defect of 2½ inches. I did a medullary bone graft and have kept the arm immobilized for a period of 18 months. It is my belief that an intramedullary transplant in no way interferes with the normal healing, nor that it is less efficient than the sliding graft. I have an X-ray of the tibia in which an absolutely normal medulla is shown 18 months after an intramedullary transplant.

Success in these cases depends upon absolute asepsis, and second, complete immobilization not only as far as flexion deformity is concerned, but as regards torsion or twisting of the bone.

Dr. Charles Davison (closing on his part): If you had seen these specimens as we took them out, there would be no question as to what we are talking about. It is not a question of live bone. Experiments with live bone show different results. If you put in a live bone transplant under the same conditions, you will find that it fastens into the medulla; that in the space between the two ends of the host fragments the transplant increases in size and it gets larger as time goes on. That is incidental. I am not arguing for live bone.

When that part of the beef bone which was encased in the medulla and covered by the endosteum became fixed and as fast as the beef bone was absorbed, its place was taken by new bone formed by the endosteum, so that part of the beef bone was kept solid at both ends in both fragments; but in that part of beef bone which was exposed between the fragments, not covered by live bone, and not protected by endosteum, there was the same or greater absorption, and there was no replacement by live bone from the host. These specimens show that whatever internal callus formation was produced, it did not bridge the defect.

There was gradual disintegration of the beef bone support, and nothing was produced to take its place; consequently a late non-union of the fracture occurred. I believe that if many of the human cases reported as successfully treated could have been followed until absorption of the beef bone took place, a period of non-union would have been found.

Dr. Daniel N. Eisendrath read a paper entitled "Urography as an aid to Abdominal Diagnosis," which will appear in a later issue.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha, Nebraska

A ROSEGARDEN FOR PREGNANT WOMEN AND MIDWIVES

THE practice and knowledge of obstetrics was one of the most neglected fields of medicine during the middle ages. So-called obstetrics consisted in neglect of normal cases and butchery of abnormal. It was considered beneath the dignity of the physician to care for an obstetrical case even as a consultant and the sense of false modesty of the times precluded his active participation in the delivery. Consequently, the management of the patient was left in the hands of ignorant and untrained midwives, and the physician was called in only to deliver hopeless cases and this was done usually by mutilation of both mother and child. Knowledge of the anatomy of the female generative organs was very meager as shown by the anatomical fugitive sheets of about 20 years later. The anatomy of the fetus and fetal membranes was handed down through the works of Hippocrates, Galen, Rhasis, and Avicenna and the illustrations in the various codices which followed the Soranus-Moschior form of the uterus and fetus which were far from correct, though they show that the various positions of the fetus *in utero* were known clinically.

The time was propitious for the study of obstetrics clinically and an attempt to do something to decrease the mortality of women during childbirth. This opportunity was grasped by Eucharius Roesslin, the elder, a physician of Worms-on-the-Rhine and Frankfort-on-the-Main (died 1526, also called Rhodion). In 1513, he published his book, which he called *Der Swangern Frauen und Hebam(m)en Rosegarten;* A Rosegarden for Pregnant Women and Midwives, which was the outstanding authority on obstetrics for over a century and was republished, somewhat altered as time went on, in various languages. Its best known form is as "The Birth of Mankynde" by Thomas Raynalde, 1565.

The name of Roesslin's book has been an enigma and several explanations for it have been offered. One has said that it was used as a play upon his name Roesslin or Roeslein, which means a little rose. Another said that it was so called because of the beautiful Rose Garden of Worms, his native city. The 1513 edition, printed in German, is a very rare volume and hence little known. In it Roesslin has written a portion of his preface in poetry and in the poem gives his reason for the name. He likens his words of advice to roses which bring brightness and joy to those who heed them, and inasmuch as he has brought them together in a book, he says that he has made a garden and so he calls his little book the Rosegarden.

The book itself is a simple and rather short compend of the subject of obstetrics. Throughout, it can be seen that he is writing for the information of midwives who apparently do all the manipulation of the actual delivery and the physician is only the consultant. He explains the usual position of the fetus *in utero* and describes the fetal membranes, which he says are three in number. The fetus is described in the "see, speak, and hear no evil position" as the normal. He divides births into natural and unnatural according to the position of the fetus, and considers the breech presentation as the most simple of the unnatural births. Later, under the management of labor, he gives detailed directions for the delivery of breech and foot presentations, and describes podalic version, which was later popularized by Paré. He likewise describes cephalic version, which he prefers. He advises waiting until the membranes bulge widely before puncturing them and gives early rupture of the membranes as one of the eighteen reasons for a difficult birth. For easy delivery he places great value on lubrication of the birth canal with various oils and salves used both manually and internally. He believes in careful preparation of the mother for delivery as an important factor in an easy birth. The directions for exercise, diet, and care of the bowels are clearly laid down in detail. Throughout the entire book the desire to make the burden of the parturient woman light and as easily borne as possible can be seen. As later, Oliver Wendell Holmes and Semmelweiss blazed the way for the avoidance of puerperal sepsis so Roesslin made the plea for care of labor and not neglect. The belief that the fetus breathed through the vagina is shown by the directions for holding the "mouth of the uterus" open should the mother die until a cæsarean section, which he advises under such a contingency, can be performed. His method of stimulating pains is rather heroic as he advises making the mother smell powdered hellebore or ground pepper to cause sneezing and so increase the abdominal contractions.

The final chapter of the book is divided into thirty-six parts, each of which treats of a different disease of the newborn child. So this portion of the work may be said to be the first special work on pediatrics.

Der frawen

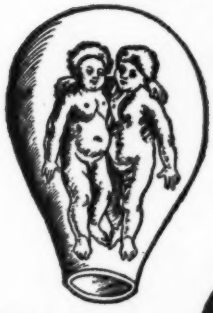
Der Frawen

Der Frawen

¶ Wann als Albertus magnus spricht vnd auch vorgesagt ist/so hat dz kind in mutter leib vor der geburt. vñ ee es sich schybt/sein angesicht/ vnd sein brust gegē seiner mütter ruckt. Dz zu der zeit der geburt/so schybt vnnd vberwürfft sich das kind gegē seiner mütter rucken /das haupt vnder sich zu vßgangk vnnd die füeß vber sich. Darumb in vßgang des kindes/kumpt des kinds angesicht vber sich gegē dē angsicht synr mütter

¶ Zů dē dritte/ so die zeit der geburt hie ist/so sol in natürlicher geburt/der vßgang des kindes behend vnd rūg sein on merckliche verlegerūg Aber das heißt die vnnatürliche geburt/die nit geschicht/ wie yetzund gesagt ist. Doch spricht Auicenna/ wā dz kinde vß mūter leib kompt zů erst nit den füessen/vnd hat sein arm/sein hend nebē seine seyten hinab vff die dicke ō bein gestreckt (als in diser figur bezeichnet ist) Das solliche ei vnnatürliche geburt sie doch sey sie aller gleichest der na-

Der frawen



¶ Wo aber die zwyling kömen. mit dē füessen/ Sol sie aber nit so thon sonder ein ander/eins nach dē andern vßfüren/in müssen als obstadt.

¶ So aber der zwyling einer kompt mit dē haupt/ der ander mit den füessē Soll abermals die hebam fleiß ankerē dem nechsten zů erst helffen/vnnd dz ander nit vlassen. Dz das soll also geschehen/ ist quetzung der beyder.

REVIEWS OF NEW BOOKS IN SURGERY

THIS exhaustive historical, pathological and clinical review is based on 2,000 cases of tuberculous caries observed in the Rizzoli Institute of Bologna, Italy. The author[1] divides his monograph into two parts: (a) general, in which he reviews the site of origin of bone abscesses, their contents, the mechanics of abscess migration and the development of the abscess itself; and (b) special, in which he discusses abscesses of the vertebral column, of the pelvis, and of the hip, knee, and shoulder joints. His conclusions are: (1) While abscesses migrate along well-determined anatomical paths, purulent tuberculous collections do not always follow such paths. (2) Generally speaking, abscesses follow muscle-sheaths and those interstitial spaces which offer the least resistance to the mechanical and biochemical action of pus. (3) Neither muscles nor aponeuroses represent insurmountable barriers to pus invasion; atypical points of escape may form in any part of the body. (4) Pus only very rarely travels along blood vessel or nerve sheaths. (5) Tuberculous pus very rarely produces vascular or nerve lesions. (6) Gravity, the ulcerative action of the tuberculous granuloma, and pressure of the abscess are the prime factors which regulate the migration of purulent collections. It is impossible to estimate which of these three factors plays the dominant rôle. TARNOWSKY.

THE object of this book[2] is to bring to the general surgeon and specialist alike the detailed results of the author's vast and ripe experience in cleft lip and palate work with the end in view that better operative results may be obtained in these distressing deformities.

Dr. Brophy may, without flattery, be called the greatest authority on all operations for cleft lip and palate. His experience in labio-palatal surgery has extended over a period of 40 years and up to 1920 has included over 5000 cleft palate operations. His development of the operative procedures in this field from the former crude methods to the perfection of the present technique, has made him famous and honored everywhere.

The bases for this book were the chapters on "Cleft Lip and Palate" in the author's book on *Oral Surgery* published in 1915. The subject has been gone into in far greater detail, and the results of more recent investigations and inventions, with many improvements in technique, have been added. The most important of these is the technique which prevents the spreading of the arch and retains the tuberosities of the maxillæ in a normal position. Great emphasis is placed on the importance of retaining the premaxillary bones in a double cleft, no matter what their position, and the excision of these bones is denounced in no uncertain terms.

The author stresses the fact that in the child a cleft palate is not the result of congenital deficiency of the parts nor arrested growth, but that with rare exceptions the normal amount of tissue is present at birth but is misplaced. This has been verified by authorities and must be accepted.

The technique of operation is described in great detail and here one will not fail to note the master mind and hand. There is also a complete description of the special instruments used with a cut of each one.

The subjects "Medical Care in Cleft Lip and Palate Patients, Infant Feeding, and Training of Speech after Cleft Palate Operations" are fully covered.

The book contains 446 illustrations and colored plates, mostly original, and those showing the author's technique are especially clear and bring out many of the fine details. An exhaustive bibliography consisting of nineteen pages in fine type is given and will be very useful to those especially interested in this subject.

In years past there have been many militant critics of the Brophy technique, but since mastering more completely all the essentials these men have almost invariably become very enthusiastic exponents of the ideas set forth by the author.

EARL THOMAS.

THIS publication[3] consists of a series of monographs, nine of which have been received for review. Forty-one have already appeared; others are listed as contemplated or in preparation. Four monographs are devoted to general diagnosis and therapy; these are concerned with the application of experimental pharmacological investigation to pharmacotherapeutics, with immunology, dietetic treatment, orthopedics, balneo- and climatotherapy, psychotherapy, general diagnosis, roentgen diagnosis, and irradiation. The specialties considered in regard to "diagnostic and therapeutic errors and their avoidance" are internal medicine, represented by 16 monographs; surgery by 12; gynecology by 3; obstetrics by 4; ophthalmology by 4; otology by 2; skin and venereal diseases by 2; and pediatrics by 6 volumes.

Among the contributors to subjects of internal medicine are Professors Hoffman, Meyer, Naegeli, Ebermayer, v. Korányi, v. Noorden, Schlesinger, Krause, and Eppinger. The surgical monographs are by Dr. Chiari and Professors Clairmont, Haberer, Koerte, Ledderhose, Mueller, Payr, Leusden, Sonntag, Tilmann and Voelcker. Gynecology is represented by Professors Henkel, Reifferscheid, and v. Jaschke, and obstetrics by Professors Fehling, Zangemeister, and Esch.

[1] LE VIE DI DEFLUSSO DEGLI ASCESSI OSSIFLUENTI. Dott. Sanzio Vacchelli. Bologna: L. Capelli, 1923.

[2] CLEFT LIP AND PALATE. By Truman W. Brophy, M.D., F.A.C.S. Philadelphia: P. Blakiston's Son & Co., 1923.

[3] IRRTUEMER DER (ALLGEMEINEN UND SPEZIELLEN) DIAGNOSTIK UND THERAPIE SOWIE DEREN VERHUETUNG. Edited by Prof. Dr. J. Schwalbe. Leipzig: Georg Thieme, 1923.

The monographs received vary in length from 77 to 329 pages. The quality of paper and the printing leave nothing to be desired. Each volume has a complete index. The various treatises are well planned. They deal in an authoritative manner with diagnosis, differential diagnosis and treatment. The style is simple, clear and concise; the discussions are comprehensive and include the more recent aids in diagnosis and treatment. Pitfalls in diagnosis are pointed out and their means of avoidance indicated by careful differential diagnosis of conditions likely to be confused. The limitations, as well as the principles and details of treatment, are emphasized. In short, these monographs impress the reviewer as exceptionally valuable expositions of our present knowledge in regard to diagnosis and treatment. One wishes that they were available in English translation. W. H. NADLER.

THIS volume,[1] with three hundred and thirty-five excellent illustrations, which is intended especially for undergraduates, more nearly meets their requirements than any other textbook in common use. In most books for students, too much space is given to operative details and different methods of performing major operations; in consequence, the text is too long and too elaborate for him to grasp the important parts pertaining to his fundamental preparation.

The recognition of diseases of the jaws and mouth and their bearing upon general disease, their differentiation and symptomatology, is of far more importance, not only to the student but to the general practitioner of medicine and dentistry as well.

After a concise review of the "Anatomy" and "Study and Diagnosis of Diseases"; "Infection, Inflammation and Its Sequelæ" are treated in a lucid manner, which facilitates teaching of these fundamentals.

Accompanying the text are pertinent illustrations which materially aid the student in fixing the subject matter in his mind, helping him to grasp the disease as an entity rather than confusing him by detailed descriptions of less relevant signs and symptoms.

This book will be of value to physicians and dentists as a reference work on diagnosis of lesions of the mouth and jaws, as well as a guide to the oral surgeon. H. A. POTTS.

RUBBER and Gutta Percha Injections[2] contains the report of the author's studies and experiments with subcutaneous injections of rubber and gutta percha for the correction of depressions of the nasal bridge and of other external contours, especially of the face.

On account of the inconstant degree of purity, he finds it necessary to "try out" each fresh supply and gives his method of so doing. In particular, he warns operators against infection and the deposition of these foreign bodies within the layers of the skin. He admonishes the operator to tell his patients that these operations are, as yet, not recognized as established surgical procedures.

The book should be helpful to anyone pursuing a similar line of study. H. A. POTTS.

[1] ESSENTIALS OF ORAL SURGERY. By Vilray Papin Blair, M.D., F.A.C.S., and Robert Henry Ivy, M.D., D.D.S., F.A.C.S. St. Louis: C. V. Mosby & Co.

[2] RUBBER AND GUTTA PERCHA INJECTIONS. Subcutaneous Injections of Rubber and Gutta Percha for Raising the Depressed Nasal Bridge and Altering External Contours. By Charles Conrad Miller, M.D. Chicago: Oak Printing & Publishing Co., 1923.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

INTERNATIONAL CLINICS. Vol. iv. Edited by Henry W. Cattell, A.M., M.D. Philadelphia and London: J. P. Lippincott Company, 1923.

THE TOXÆMIA OF ACUTE INTESTINAL OBSTRUCTION OR VOMITING AS A PATHOLOGICAL FORCE. By R. H. Paramore, M.D. (Lond)., F.R.C.S. (Eng.). London: H. K. Lewis & Co., Ltd., 1923.

A SYSTEM OF SURGERY. Vols. i, ii, and iii. Edited by C. C. Choyce, C.M.G., C.B.E., B.Sc., M.D., F.R.C.S. Pathological Editor, J. Martin Beattie, M.A., M.D., C.M. New York: Paul B. Hoeber, 1923.

LOCAL ANÆSTHESIA. Its Scientific Basis and Practical Use. 2d American from the 6th rev. German edition. By Prof. Dr. Heinrich Braun. Translated and edited by Malcolm L. Harris, M.D. Philadelphia and New York: Lea & Febiger, 1924.

ANNUAL REPORT OF THE SURGEON GENERAL OF THE PUBLIC HEALTH SERVICE OF THE UNITED STATES. For the Fiscal Year 1923. Washington: Government Printing Office, 1923.

OPERATIVE SURGERY. Covering the Operative Technique Involved in the Operations of General and Special Surgery. Vols. i and ii. By Warren Stone Bickham, M.D. and Phar. M., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1924.

CLINICAL LABORATORY METHODS. By Russell Landram Haden, M.A., M.D. St. Louis: C. V. Mosby Company, 1923.

MANAGEMENT OF THE SICK INFANT. 2d rev. ed. By Langley Porter, B.S., M.D., M.R.C.S. (Eng.), L.R.C.P. (Lond.), and William E. Carter, M.D. St. Louis: C. V. Mosby Company, 1924.

PRACTICAL CHEMICAL ANALYSIS OF BLOOD. 2d rev. ed. By Victor Caryl Meyers, M.A., Ph.D. St. Louis: C. V. Mosby Company, 1924.

SELECTED ESSAYS ON ORTHOPÆDIC SURGERY. By Newton Melman Shaffer, M.D., F.A.C.S. New York and London: G. P. Putnam's Sons, 1923.

HEALTHY BABIES, HEALTHY CHILDREN, AND HEALTHY MOTHERS. iii vols. By S. Josephine Baker, M.D., D.P.H. Boston: Little, Brown and Company, 1923.

DOEDERLEIN-KROENIG OPERATIVE GYNAEKOLOGIE. 5th ed. By Dr. med. et Dr. art. obs. h. c. Albert Doederlein. Leipzig: George Thieme, 1924.

DER DARMVERSCHLUSS UND DIE SONSTIGEN WEGSTOERUNGEN DES DARMES. By Prof. Dr. W. Braun and Dr. W. Wortmann. Berlin: Julius Springer, 1924.

MODERN UROLOGY. In Original Contributions by American Authors. Vols. i and ii. 2d ed. revised. Edited by Hugh Cabot, M.D., C.M.G., F.A.C.S. Philadelphia and New York: Lea & Febiger, 1924.

SURGICAL PATHOLOGY. By Joseph McFarland, M.D., Sc.D. Philadelphia: P. Blakiston's Son & Company, 1924.

EIGHTH SCIENTIFIC REPORT ON THE INVESTIGATIONS OF THE IMPERIAL CANCER RESEARCH FUND. London: Taylor and Francis, 1923.

EMERGENCY OPERATIONS FOR GENERAL PRACTITIONERS ON LAND AND SEA. By H. C. Orrin, O.B.E., F.R.C.S. (Edin.). New York: William Wood & Company, 1924.

LECTURES ON ENDOCRINOLOGY. By Walter Timme, M.D. New York: Paul B. Hoeber, Inc., 1924.

LA TENSIÓN ARTERIAL Y VISCOSIDAD SANGUINEA EN EL ESTADO PUERPERAL. By Dr. Francisco A. Deluca. Buenos Aires: Imprenta Mercatali, 1923.

AN INTRODUCTION TO SURGICAL UROLOGY. By William Knox Irwin, M.D. (Aberd.), F.R.C.S. (Edin.). New York: William Wood & Company, 1924.

BIOLOGIE UND PATHOLOGIE DES WEIBES. Ein Handbuch der Frauenheilkunde und Geburtshilfe. Edited by Josef Halban, Wien, and Ludwig Seitz, Frankfurt a.M. No. 4.—Normale Entwicklungsgeschichte der weiblichen Geschlechtsorgane des Menschen, by Prof. Dr. W. Lubosch, Wuerzburg; Anatomie, Histologie und Topographie des weiblichen Urogenitalapparates, by Priv.-Doz. Dr. O. Oertel, Koeln; Vergleichende Anatomie der weiblichen Geschlechtsorgane der Haussaugetiere (Huftiere u. Fleischfresser), by Prof. Dr. R. Schmaltz, Berlin; Rassenlehre, by Prof. Dr. C. H. Stratz, Haag; Physiologie der weiblichen Genitalorgane, by Prof. Dr. L. Fraenkel, Breslau. Berlin: Urban & Schwarzenburg, 1923.

INTRANASAL SURGERY. By Fred J. Pratt, M.D., F.A.C.S., and John A. Pratt, M.D., F.A.C.S. Philadelphia: F. A. Davis Company, 1924.

PRACTICAL ELECTROTHERAPEUTICS AND DIATHERMY. By G. Betton Massey, M.D. New York: The MacMillan Company, 1924.

OBSTETRICAL NURSING; A Manual for Nurses and Students and Practitioners of Medicine. 2d ed. rev. By Charles Sumner Bacon, Ph.B., M.D. Philadelphia and New York: Lea & Febiger, 1924.

A PHYSICIAN'S MANUAL OF VACCINE THERAPY. By G. H. Sherman, M.D. Detroit: Press of the Bacteriological Laboratories of G. H. Sherman, M.D.

DIE ROENTGENBEHANDLUNG DES UTERUSKARZINOMS. By Dr. Med. et Phil. Hermann Wintz. Leipzig: Georg Thieme, 1924.

THE CULTURE OF THE ABDOMEN. By F. A. Hornibrook. Preface by Sir William Arbuthnot Lane (Bart.), C. B., M.S. London: William Heinemann, Ltd., 1924.

PAPERS AND ADDRESSES IN SURGERY. By R. Hamilton Russell, F.R.C.S. (Eng.). Melbourne: Allan Grant, 1923.

DIE GYNAEKOLOGISCHE OPERATIONSTECHNIK. Der Schule Ernst Wertheims. Edited by Professor Dr. Wilhelm Weibel. Berlin: Julius Springer, 1923.

CORRESPONDENCE

BLUISH DISCOLORATION OF UMBILICUS IN CONDITION OTHER THAN RUPTURED ECTOPIC GESTATION

To the Editor: Bluish discoloration about the umbilicus has been described by Cullen[1] and Novak[2] in recent articles, and it is claimed that this sign is pathognomonic of free blood in the peritoneal cavity accompanied by ruptured ectopic pregnancy. I have observed this sign to be true in several cases but not always constant. Lately it was noted to be present in a lesion quite the contrary.

Patient, age 25, married and nulliparous, complained of a pain in the left lower abdomen, which had not been present except the last 15 days. The history is unessential except patient has always enjoyed good health. There have been no abnormalities about menstruation and patient has never been pregnant. She missed the last period and at time of examination was 10 days beyond the appearance time. She has had no vaginal bleeding. Patient is a well nourished woman, and examination is negative except for lower abdomen and pelvic organs. Abdomen is symmetrical and no muscle spasm is present. *A greenish blue discoloration is noted about umbilicus. It is circumscribed and about 3 centimeters in diameter. The color is most intense in the center and fades at the periphery.* No free abdominal fluid is present but abdomen is sensitive to palpation in region of left tube and ovary, where an oblong mass, fixed, smooth, firm, and about the size of a hen's egg is found. The external genitalia are normal and no bloody discharge is present. The cervix is soft, patulous, and freely movable. The uterus is slightly enlarged and the right tube and ovary are normal. The mass on left side which was noted on abdominal examination, is confirmed.

On opening the abdomen no free fluid was present. The uterus was found to be about the size of a 6 weeks' pregnancy. The tubes and right ovary were normal, but there was a cyst of the left ovary about 6 centimeters by 4 centimeters, which was adherent to the broad ligament. The left tube and cystic ovary were removed. Diagnosis was normal pregnancy and left ovarian cyst.

A report of one case is not very satisfactory but it does show conclusively that the sign is not pathognomonic for the lesion mentioned. It is hoped that this presentation will stimulate the interest to look for other abdominal lesions in which it could easily be present and from which some definite conclusions as to its cause may be made.

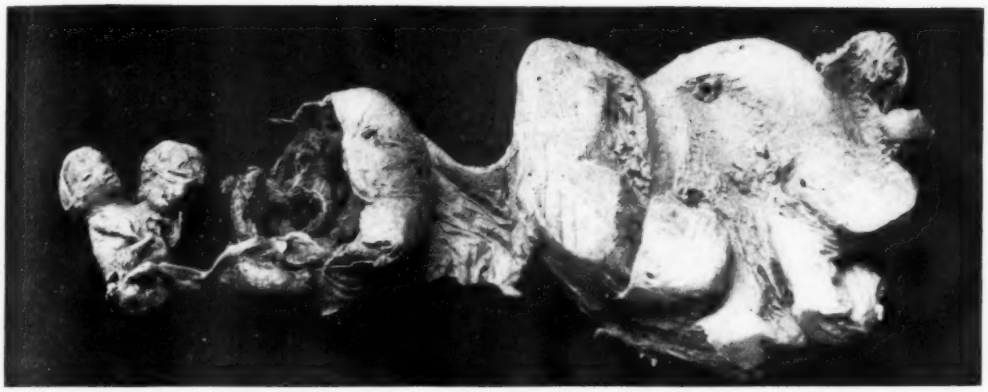
LEWIS CLARK WAGNER, M.D.
65 Park Avenue, New York.

[1] Surg., Gynec. & Obst.
[2] J. Am. M. Ass.

MYOMATOUS UTERUS WITH RUPTURED TUBAL PREGNANCY AND EMBRYONIC DOUBLE MALFORMATION

To the Editor: I am reporting this case as of interest in connection with the article of Arey on tubal twins published in SURGERY, GYNECOLOGY AND OBSTETRICS, 1923, xxxvii, 407. I cannot furnish any clinical data as the protocols have been lost; so I have to restrict myself to the simple facts which are taken from the rich anatomical collection of the Queen Helena Civic Hospital of Trieste, the superintendent of which, Dr. Ferrari, I wish to thank very heartily for his kindness in placing the material at my disposal.

Many years ago a young anæmic woman was brought to the hospital and died immediately after admission. Autopsy showed the cause of death to be an internal hæmorrhage which had originated from a ruptured pregnant tube. Examination of the genitalia rendered the following very interesting findings (Fig. 1). The uterus was about 12 centimeters long and about 3 centimeters thick and showed a myoma nodule larger than a nut, situated in the neighborhood of the internal os uteri. The mucous membrane of the uterine cavity showed immense proliferation and villous structure on the right side. The right ovary was of normal size and shape, while the tube, which was the size of a goose egg in its ampullar part, showed in front a gaping, irregular tear 7 centimeters in length through which chorionic villi might be distinctly seen covering the entire internal wall. From there originated a thin umbilical cord 10 centimeters long, which communicated with the abdominal cavity of the free-lying fetus. The fetus was 9 centimeters long and consisted of a trunk with two independent heads which were connected with the trunk by one neck each. On the left and the right side of the trunk, one upper and one lower extremity had developed on



each. The case thus concerns a dicephalus diauchenos dibrachius dipus. The left adnexa do not show any deformities.

As far as I am acquainted with the literature, there is no other record of ectopically developed fetus except the case reported by Kirchhoff (Ein Thoracopagus im tubaren Fruchtsacke. Zentralbl. f. Gynaek., 1894, No. 10), which was also mentioned by Arey.

PROF. DOTT. PIERO GALL.

Trieste, Italy.

ABDOMINOSCOPY

To the Editor: In the February, 1924, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, I discussed abdominoscopy and referred to it as a new method. This was my true belief as I could find in the literature at my disposition no record of such a method of examination. Since my article appeared it has been brought to my attention that the procedure had previously been described. In view of the earlier work I forfeit the claim of priority.

I have been informed that this method was described by Kelling in 1902 (Muenchen med. Wchnschr., 1902, No. 1, p. 21), and by Jacobaeus in 1910 (Muenchen med. Wchnschr., 1910, No. 40, p. 2090; also by Orndoff (J. Radiol.), 1920, May. The method has also been practically applied. I regret that at this time this literature is not accessible, therefore for details of their work I have to refer those interested to these papers.

Otto P. Steiner, M.D.

Atlanta, Georgia.

AMERICAN COLLEGE OF SURGEONS

STATE MEETINGS OF THE CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

ILLINOIS, MISSOURI, AND KANSAS; TEXAS, OKLAHOMA, AND NEW MEXICO; MISSISSIPPI, LOUISIANA, AND ARKANSAS; KENTUCKY AND TENNESSEE; GEORGIA, ALABAMA, AND FLORIDA; NORTH AND SOUTH CAROLINA; AND NEBRASKA

ILLINOIS, MISSOURI, AND KANSAS

THE first sectional meeting of the Clinical Congress of American College of Surgeons for 1924 was held at the Statler Hotel, St. Louis, on January 18 and 19. This meeting was for the states of Illinois, Missouri, and Kansas.

The visiting speakers on the program were Dr. A. J. Ochsner, Chicago; Dr. Charles H. Mayo, Rochester, Minnesota; Dr. James T. Case, Battle Creek, Michigan; Rev. C. B. Moulinier, S.J., Milwaukee; Dr. Allan Craig, Chicago; Dr. M. T. MacEachern, Chicago.

The arrangements were in the hands of a local committee, with Dr. Paul Y. Tupper as chairman, and Dr. Fred W. Bailey as secretary. All the meetings were well attended and the clinics were interesting and instructive.

Executive Committees for the three states for the coming year were elected as follows:

Missouri

Chairman—Dr. Herman E. Pearce, Kansas City
Secretary—Dr. William A. Shelton, Kansas City
Counselor—Dr. Robert L. Neff, Joplin

Illinois

Chairman—Dr. Carl E. Black, Jacksonville
Secretary—Dr. O. L. Pelton, Jr., Elgin
Counselor—Dr. E. B. Montgomery, Quincy

Kansas

Chairman—Dr. H. L. Snyder, Winfield
Secretary—Dr. W. M. Mills, Topeka
Counselor—Dr. J. L. Evans, Wichita

TEXAS, OKLAHOMA, AND NEW MEXICO

The sectional meeting for Texas, Oklahoma, and New Mexico of the Clinical Congress of American College of Surgeons convened at the Texas Hotel, Fort Worth, January 22 and 23.

The visiting speakers on the program were Dr. James T. Case, Battle Creek, Michigan; Dr. W. C. MacCarty, Rochester, Minnesota; Dr. M. T. MacEachern, Chicago; Rev. C. B. Moulinier, S.J., Milwaukee; Mr. Robert Jolly, Houston; Dr. Allan Craig, Chicago.

Dr. Bacon Saunders of Fort Worth was chairman of the Texas State Committee. There was an excellent attendance of Fellows of the College.

Executive Committees for the states of Texas and Oklahoma for the coming year were elected as follows:

Texas

Chairman—Dr. Bacon Saunders, Fort Worth
Secretary—Dr. Everett Jones, Wichita Falls
Counselor—Dr. W. R. Russ, San Antonio

Oklahoma

Chairman—Dr. LeRoy Long, Oklahoma City
Secretary—Dr. F. L. Carson, Shawnee
Counselor—Dr. Thomas M. Aderhold, El Reno

MISSISSIPPI, LOUISIANA, AND ARKANSAS

The sectional meeting for Mississippi, Louisiana, and Arkansas was held at the Edwards Hotel, Jackson, Mississippi, January 25 and 26.

The visiting speakers on the program were Dr. James T. Case, Battle Creek, Michigan; Dr. W. C. MacCarty, Rochester, Minnesota; Dr. M. T. MacEachern, Chicago; Mr. Robert Jolly, Houston; Dr. Allan Craig, Chicago.

Dr. John W. Barksdale, chairman of the State Committee, presided at the meetings. The arrangements were excellently carried out by the local committee and all meetings were well attended.

Executive Committees for 1924 were elected as follows:

Mississippi

Chairman—Dr. W. W. Crawford, Hattiesburg
Secretary—Dr. J. P. Wall, Jackson
Counselor—Dr. W. L. Britt, Jackson

Arkansas

Chairman—Dr. J. S. Jenkins, Pine Bluff
Secretary—Dr. A. E. Chace, Texarkana
Counselor—Dr. W. F. Smith, Little Rock

Louisiana

Chairman—Dr. J. C. Willis, Shreveport
Secretary—Dr. C. G. Cole, New Orleans
Counselor—Dr. L. B. Crawford, Patterson

KENTUCKY AND TENNESSEE

The Kentucky and Tennessee section of the Clinical Congress of American College of Surgeons met at the Hermitage Hotel, Nashville, January 28 and 29.

Dr. George R. West, of Chattanooga, chairman of the Tennessee Executive Committee, presided at the meetings.

The visiting speakers on the program were Dr. James T. Case, Battle Creek, Michigan; Dr. Frank C. Mann, Rochester, Minnesota; Mr. Robert Jolly, Houston; Dr. M. T. MacEachern, Chicago; Dr. Allan Craig, Chicago.

The arrangements were in the hands of a local committee with Dr. Robert Caldwell as chairman and Dr. A. L. Sharber as Secretary.

Executive Committees for the coming year were elected as follows:

Tennessee

Chairman—Dr. Battle Malone, Memphis
Secretary—Dr. Victor D. Halloway, Knoxville
Counselor—Dr. Perry Bromberg, Nashville

Kentucky

Chairman—Dr. Irvin Abell, Louisville
Secretary—Dr. Elmer L. Henderson, Louisville
Counselor—Dr. David Y. Roberts, Louisville

GEORGIA, ALABAMA, AND FLORIDA

The Georgia, Alabama, and Florida sectional meeting of the Clinical Congress of American College of Surgeons met at the Georgian Terrace Hotel, Atlanta, January 31 and February 1.

Dr. William S. Goldsmith, chairman of the Georgia Executive Committee, presided at the meetings.

The visiting speakers on the program were Dr. James T. Case, Battle Creek, Michigan; Dr. F. C. Mann, Rochester, Minnesota; Mr. Robert Jolly, Houston, Texas; Dr. M. T. MacEachern, Chicago; Dr. Allan Craig, Chicago; Dr. J. R. B. Branch, Changsha, China.

The clinics and hospital meetings were held at the Academy of Medicine. All were well attended.

Executive Committees for the various states were elected for the coming year as follows:

Georgia

Chairman—Dr. E. G. Ballenger, Atlanta
Secretary—Dr. G. P. Huguley, Atlanta
Counselor—Dr. W. P. Harbin, Rome

Florida

Chairman—Dr. John S. Helms, Tampa
Secretary—Dr. F. J. Waas, Jacksonville
Counselor—Dr. J. E. Boyd, Jacksonville

Alabama

Chairman—Dr. E. P. Hogan, Birmingham
Secretary—Dr. John O. Rush, Mobile
Counselor—Dr. Samuel Kirkpatrick, Selma

NORTH AND SOUTH CAROLINA

The North and South Carolina section of the American College of Surgeons was held at the Robert E. Lee Hotel, Winston-Salem, February 4 and 5.

The visiting speakers were Surgeon General Meritte W. Ireland, Washington, D. C.; Dr. James T. Case, Battle Creek, Michigan; Dr. J. R. B. Branch, Changsha, China; Dr. M. T. MacEachern, Chicago; Dr. Allan Craig, Chicago.

The local committee of arrangements provided excellent facilities for all the meetings and there was a good attendance.

The State Committees for the coming year were elected as follows:

North Carolina

Chairman—Dr. John T. Burris, High Point
Secretary—Dr. John Wesley Long, Greensboro
Counselor—Dr. Charles M. Strong, Charlotte

South Carolina

Chairman—Dr. Robert S. Cathcart, Charleston
Secretary—Dr. D. L. Maguire, Charleston
Counselor—Dr. Samuel O. Black, Spartanburg

NEBRASKA

The Sectional Meeting of the American College of Surgeons for the state of Nebraska was held at the Fontenelle Hotel, Omaha, February 18 and 19.

The visiting speakers on the program were Dr. A. J. Ochsner, Chicago; Dr. James T. Case, Battle Creek, Michigan; Dr. Emil Beck, Chicago; Dr. Carl Hedblom, Rochester, Minnesota; Rev. C. B. Moulinier, S.J., Milwaukee; Dr. M. T. MacEachern, Chicago; Dr. Allan Craig, Chicago.

All the arrangements were in the hands of the local state committee with Dr. A. F. Jonas, of Omaha, as chairman. Dr. Jonas presided at all the meetings.

The Nebraska State Committee for 1924 was elected as follows:

Chairman—Dr. A. F. Jonas, Omaha
Secretary—Dr. William L. Shearer, Omaha
Counselor—Dr. J. Stanley Welch, Lincoln

1924 CLINICAL CONGRESS IN NEW YORK AND BROOKLYN

THE fourteenth annual session of the Clinical Congress of the American College of Surgeons will be held in New York and Brooklyn beginning on Monday, October 20, and ending on Friday, October 24, 1924. General headquarters will be at the Waldorf-Astoria Hotel.

Local executive committees in charge of arrangements for the meeting have been appointed as follows:

NEW YORK

Eugene H. Pool, Chairman
John A. Vietor, Secretary

Cornelius G. Coakley	Charles H. Peck
William A. Downes	Robert G. Reese
Arthur B. Duel	J. Bentley Squier
Benjamin P. Farrell	William E. Studdiford
Alfred T. Osgood	George Gray Ward, Jr.

BROOKLYN

John E. Jennings, Chairman
Thomas M. Brennan, Secretary

Warren L. Duffield	Frank D. Jennings
Edwin H. Fiske	William Linder
Russell S. Fowler	Ralph I. Lloyd
Emil Goetsch	John O. Polak
Charles A. Gordon	Nathaniel P. Rathbun
O. Paul Humpstone	Jaques C. Rushmore

Charles E. Scofield

The plans for the New York meeting, which will be the third session of the Clinical Congress to be held in that city, will conform in a general way to those of previous sessions. The mornings and afternoons of the four days, Tuesday to Friday, inclusive, will be devoted to clinical demonstrations in the hospitals and medical schools with scientific sessions each evening.

A conference on the hospital standardization program of the College and the many problems relating thereto will occupy the morning and afternoon hours on Monday. The presidential meeting, the first formal session of the Congress, will be held in the ballroom of the Waldorf-Astoria on Monday evening, on which occasion the president-elect, Dr. Charles H. Mayo, will be inaugurated and will deliver the annual address. The twelfth convocation of the American College of Surgeons will be held in the ballroom of the Waldorf-Astoria on Friday evening.

The Committees on Arrangements for both Brooklyn and New York have in preparation a program of clinics and demonstrations to be given in the hospitals and medical schools that will completely present the clinical activities of that great medical center. All departments of surgery will be represented therein including general surgery, gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat and mouth, experimental surgery, surgical pathology, roentgenology, etc. It is expected that a preliminary program will be published in these pages in an early issue.